AMERICAN ENGINEER AND RAILROAD JOURNAL.

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CONTENTS.

AMERICAN ENGINEER TESTS.

Locomotive Draft Appliances.

III.

THE THEORIES TO BE INVESTIGATED.

A Research by H. H. Vaughan,
Member A. S. M. E.

On carefully reading the Hanover experiments, several things appear rather questionable. Apart from the question of efficiency when larger quantities of air were admitted, which is not touched upon in the report, I should have supposed that the most efficient stack was that which with a given sized nozzle produced the greatest vacuum. If the vacuum varies directly with the pressure in the exhaust pipe, this would give the highest vacuum at all pressures if it gave it with one, although it would not of course follow directly that the stack which gave the best results with one size of nozzle would be the best stack for another size. Then if on an engine a nozzle, say 4¾ ins. in diameter, was found to give a greater draught than was necessary, the proper plan would be to enlarge the nozzle. As a matter of fact the experiments show that whatever the size of the nozzle may be the highest vacuum is obtained with a conical stack 11.8 ins. in diameter and of 1 in 6 taper, although there is very little difference between this stack and the other of the same diameter but 1 in 12 taper. This diameter of 11.8 ins. is also the smallest tested. Now in the Hanover report it is stated that the stacks having the greatest indraft of air are not the most suitable for locomotives on account of the sparks thrown, etc. By in-draft of air is practically meant vacuum obtained, and I cannot help the conclusion that the idea carried through the report is that a stack giving less vacuum is preferable to the most efficient form on this account, in place of keeping the most efficient stack and enlarging the diameter of the nozzle in such a case, and thus obtaining the lowest possible back pressure. Fig. 5 shows clearly the reduction in vacuum found in both sets of experiments when the nozzle is enlarged and the same amount of steam discharged. This point may appear small, but the same idea is carried through the entire report and it appears to me to be founded on an erroneous way of looking at the question.

In Section III the recommendation for nozzle distance must, of course, be modified in accordance with the Master Mechanics' Association results, as shown in Figs. 1, 2, 3, 4, and it is worthy of notice that in the recommendation for the total height of stack, that this height is the distance from the top of the nozzle to the top of the stack and not simply the height of the stack itself.

In the experiments on shortened stacks the statement is made that if the nozzle distance is increased as the stack is shortened the same vacuum can be obtained. While this is true in one way, yet it should be noticed that the highest vacuum that can be obtained with a shortened stack is always less and often considerably less than that which can be obtained in the full length stack.

Several examples are given of stacks which caused spark throwing, in connection with a peculiarity of the experimental apparatus, throwing water under certain conditions. This action was cured by the substitution of stacks which gave a reduced vacuum, and the question naturally arises whether an increase of nozzle diameter would not have remedied the trouble equally as well and decreased the back pressure at the same time.

A large number of experiments on nozzles fitted with a bridge led to the endorsement of this appliance. This directly contradicts the results of the Master Mechanics' Association experiments, but the advantage or disadvantage is in any case very small.

A series of tests to determine the angle of the steam jet gave a most extraordinary result, that the angle of the jet was in all cases 1 in 2.41. As the average angle found in the Master Mechanics' Association experiments is 1 in 6.4, there is evidently some discrepancy in the method employed to measure the angle. In the Hanover tests themselves the jet could not have maintained this angle, since as the greatest vacuum with a conical stack without waist 13.78 ins. in diameter with a 4¾-in. nozzle is obtained 30 ins. from the bottom of the stack, it is evident the jet cannot maintain any such angle, as its diameter would be 17.75 at the point at which it enters the stack.

In general, granted the fact that spark throwing does and can only arise from excessive draught, I cannot avoid the conclusion that while the results of the Hanover tests as a whole may be of great value the deductions made from those tests in the report are from a wrong standpoint and should only be used in connection with the results themselves.

The curious discrepancy in the angle formed by the steam jet in these and the Master Mechanics' Association tests appears to me of considerable importance, and careful consideration of the results in the latter instance has considerably modified my ideas of this subject, which were exceedingly hazy. At the risk of being tedious I am free to say that I had always considered the steam jet as being at some considerable pressure and that the increase in diameter of the jet was caused by the expansion from this to a lower pressure. Now this is not the case. Experiments on jets flowing through orifices of various forms from a pressure of as much as 200 lbs., show that only with the thinnest plates is there any expansion of the jet after leaving the orifice, and that when this does take place the jet is parabolic in form for a short distance. Nothing of this form is visible in the case of the jet from the exhaust pipe, and it is, therefore, certain that in this case the jet has expanded to the pressure of the gases in the front end by the time it has left the nozzle, and is really a stream of particles flowing at the velocity due to the difference of pressure in the exhaust pipe and in the smokebox. Now as this steam passes through the gases it induces movement in them and itself loses correspondingly in velocity. At constant pressure and tem-

perature the amount of steam passing any section per second must of course be constant, and this amount is the product of the area of the jet multiplied by its mean velocity, and therefore apart from any entraining action as the jet loses velocity it must spread, and it is the rate of this spreading which forms the angle of the jet, and it is not due to any expansion of the steam.

Here I wish to make a few remarks on elementary things which are simple enough, but which I have found it necessary to get quite straight in considering this subject. The difference of pressures that we are dealing with is exceedingly small. For instance, 4 ins. of water = 0.1445 lbs. per square inch. The exhaust pipe pressure in the Hanover tests, 3.94 ins. of mercury = 1.932 lbs. per square inch. The rate of flow of a gas under slightly different pressure, P_1 and Po, is given by

$V^2 = \frac{2g}{Wo}(P_1 - Po)$, Wo = weight of gas, all dimensions being pounds, feet and seconds. The weight of steam at 14.5 lbs. per square inch is 0.0378 lbs. per cubic foot, of air at 60 degs. is 0.077 lbs. per cubic foot, or roughly double that of steam.

The velocity of flow of air from atmospheric pressure into the following vacuums is as follows in feet per second:

Vacuum, inches.	Air at 50 deg.	Air at 760 deg.
1	65	80
2	92	113
3	113	138
4	130	160
5	145	179
6	159	196

The very slight difference of pressure between the front end and the atmosphere leads to the conclusion that apart from temperature changes there is but very slight change in the volume of either gas or steam in passing out into the atmosphere. With a smokebox vacuum of 4 ins. of water the change at atmospheric pressure or from 14.555 to 14.7 lbs. per square inch is only as 100 to 101. It is therefore entirely negligible, so that if the steam jet is not condensed or superheated the same volume of stuff must pass any section per second that issues from the nozzle. Now, while the only observation made in the Hanover experiments was the angle of the jet, the Master Mechanics' Association report gives considerable information on this subject. Figs. 6 to 23 in that report give the velocity of the jet at various distances from the nozzle and axis, while Fig. 2 shows what was in the light of previous knowledge a most curious state of affairs in the vacuum found in the stack. In Figs. 6 to 23, Figs. 9, 10, 11 give the form of jet obtained by a steady blow with low bridge pipe, and as this is the simplest condition it is the one I have attempted to analyze. In Figs. 7, 8, 9, are plotted the velocities shown in the report at distances of 11⅞, 15 9/16 and 19 11/16 ins. from the nozzle, in each case the curve marked "a" corresponding to the least, "b" to the next and "c" to the greatest distance. The abscissae represent circular inches of area, while the ordinates represent the velocity in feet per second.

The rectangles in each figure represent the velocity of flow at the nozzle multiplied by the area in circular inches, in other words the volume of stuff per second that issues from the nozzle. Now the curious point about these diagrams is that in each case they show that considerably more stuff passes each section per second than issues from the nozzle, and this is the case in other jets shown in the Master Mechanics' Association report that I have plotted, to even a larger degree. As this cannot be due to the expansion of the jet it must be due to the entrainment of air. Not knowing the reasons for the statement in the Master Mechanics' Association report that in all the jets examined the inducing action is great and the entraining action small, I feel that my statement should be accepted conditionally, but the above fact would certainly indicate that the entraining action exists. In Figs. 10 and 11 the jets illustrated in Figs. 10 and 11 of the Master Mechanics' Association reports are plotted with the abscissae representing circular inches as before, while the ordinates are the squares of the velocities, so that the area in these diagrams represents the energy of the jet, only sections "a" and "c" are plotted and the jet shown in Master Mechanics' Association Fig. 9 is not plotted, as since only two velocity lines are given, it is impossible to do it accurately.

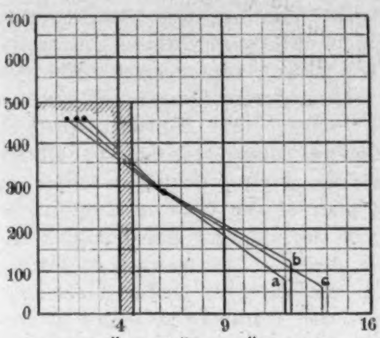
In these diagrams the rectangles represent the energy of the jet on leaving the nozzles. Of course on such slight information absolute accuracy is impossible, yet remembering that air at 750 degs. weighs very nearly the same as steam, these diagrams show that the energy of the jet is constant, or that but little is lost in inducing currents, but that the velocity of the steam has been reduced by giving velocity to the gases entrained in the jet, so that the energy is the same. This point must be remembered, that when the jet leaves the nozzle it would simply flow in straight lines if the pressure of the gases enclosing it were unchanged and they offered no resistance to its motion, so that apart from inducing or entraining action the velocity of its particles cannot change without change in pressure, in which case part of the velocity is transformed into an increase in pressure. In other words, if M and P are constant, $\frac{Mv^2}{2}$ is constant and cannot change. If velocity is imparted to other gases by entraining, M is increased and v diminished, $\frac{Mv^2}{2}$ being constant; if by induction M is constant and $\frac{Mv^2}{2}$ is diminished, the $\frac{Mv^2}{2}$ being constant if mass of induced gases is taken into account. Now any of the figures in the Master Mechanics' Association diagrams will show that Mv is increased, and increased too much to be accounted for by the steam in the jet being heated by the smokebox gases, if indeed this could take place in the absence of great entraining action. The energy cannot be plotted for most of the jets from the data in the report, but this should be done, and if constant or increasing with the distance from the nozzle it would certainly prove that the inducing action is small.

There is another fact to support this idea. In Fig. 2 of the Master Mechanics' Association report, it is shown that the vacuum above the foot of the stack is 1.5 times that in the smokebox. The jet plotted in Fig. 8 would produce a smokebox vacuum of 2.75 ins. or a vacuum at the foot of the stack of 4.12 ins. This air is hot, and if it is at such a vacuum it must have sufficient velocity to restore it to atmospheric pressure at the top of the stack, and if we take its temperature at 765 degs. this velocity would have to be 160 ft. per second. By reference to Fig. 8 it can be seen that the velocity of the steam at the edge of the jet is only 150 ft. per second and this is at some distance from the stack; there is no evidence in the Master Mechanics' Association Fig. 2 of any change in the relation of the jet and the surrounding air until right at the top of the stack and it is unlikely that all the surrounding air in the stack is moving as rapidly as the edge of the jet. Therefore, first, it is very unlikely that this air would have sufficient energy to flow into the atmosphere unless entrained in the steam. Second, if it did have sufficient for this its velocity near the top of the stack would not be sufficient to remove enough air per second to cause the registered vacuum in the smokebox. By this I mean that the production of a vacuum in the smokebox means that a certain amount of air was removed per second. Now the firebox vacuum in these tests was one-third the smokebox vacuum. The area through which air could flow was 185 sq. ins. At a vacuum of one-third of 2¾, or 0.92 in., air would flow in with a velocity of about 60 ft. per second, so that apart from the great increase in volume caused by this air being heated, it must have flowed out of a 16-in. stack of 200 sq. ins. area at about 55 ft. per second if distributed over the entire area. If we consider that if this air surrounded the jet as an induced current, it could not have flowed through

at the outside over 50 to 60 ins. area, that it was expanded at any rate to 50 per cent. greater volume through heating, so that it would have had to flow under a velocity of about 270 ft. per second at the top of the stack, a velocity much greater than that of the edge of the jet, it appears to me the induction idea is untenable.

On the other hand I have attempted to make some calculations on the assumption that the energy of the jet is constant,

If V_1 is the velocity of jet on leaving the nozzle, and A_1 the area of the nozzle, we know that at any point if A_s = area of steam in the jet and A_a = area of air in the jet, and V is the mean velocity at that point, that $A_1 V_1 = A_s V_1$ since the quantity of steam passing per second is constant. Now let A_x = area at that point. We know A_x at any point since the angle of the jet is assumed. Also since the energy is constant and mass of A_a = twice that of A_s.



a = 11⅞″, b = 15 5/16″, c = 19 11/16″ from Nozzle

Fig. 7

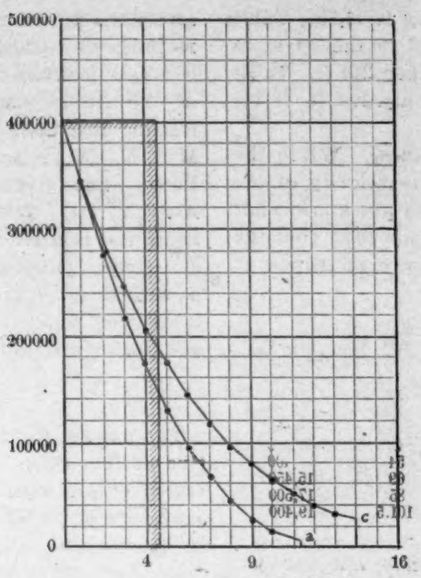


Fig. 10

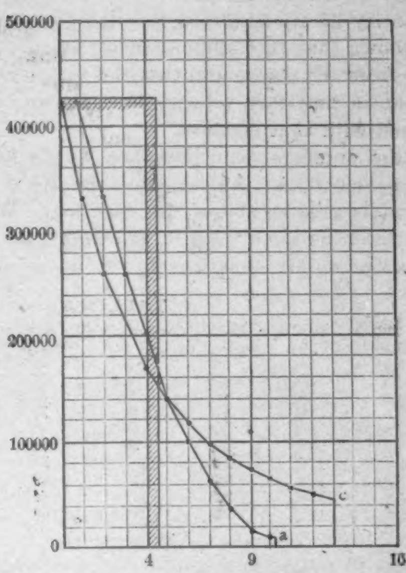
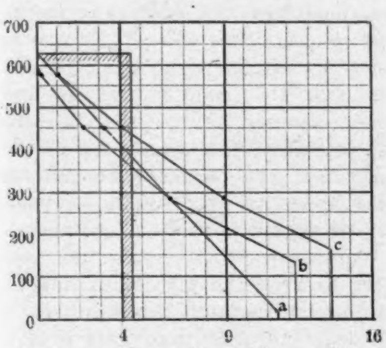
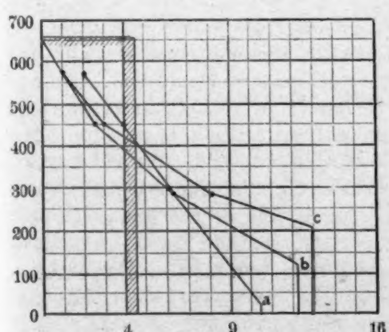


Fig. 11



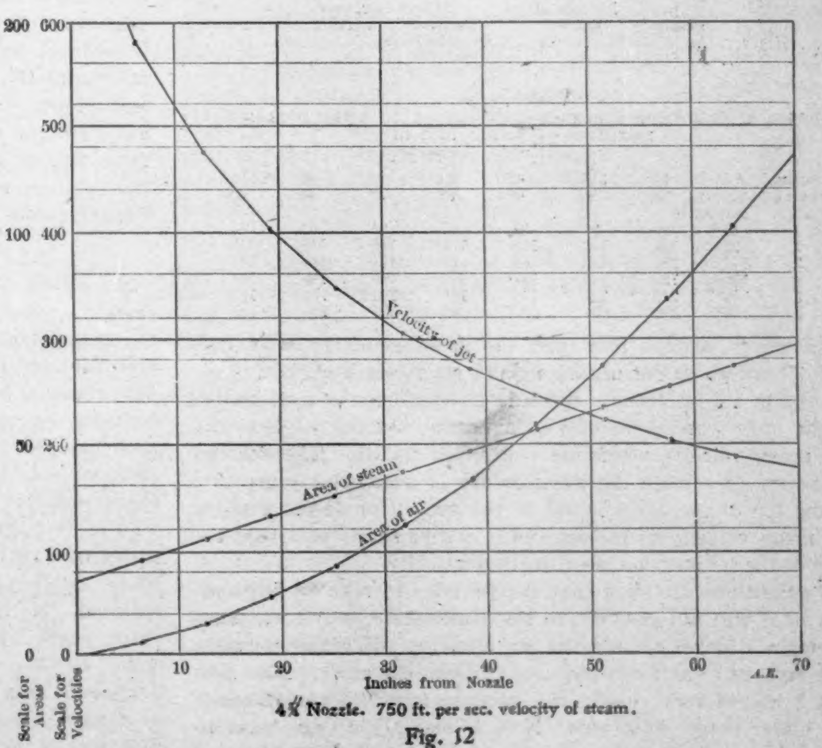
a = 11⅞″, b = 15 5/16″, c = 19 11/16″ from Nozzle

Fig. 8



a = 11⅞″, b = 15 5/16″, c = 19 11/16″ from Nozzle

Fig. 9



4¾″ Nozzle. 750 ft. per sec. velocity of steam.

Fig. 12

American Engineer Tests On Locomotive Draft Appliances.

that the angle of the jet is 1 in 6.4, and that there is no heat transference between the steam and air, that the conditions of the Hanover tests are maintained, namely, pressure of 3.94 ins. of mercury in the exhaust pipe, and admission openings of 80.72 sq. ins. to the smokebox, and the results are rather interesting. The following calculations may be skipped, but I give them for criticism.

Air at 50 degs. is roughly twice the weight of steam, so let us adopt that proportion.

$(A_s + 2 A_a) V^2 = A_1 V_1^2$,

or since $A_s + A_a = A_x$,

$(2 A_x - A_s) V^2 = A_1 V_1^2$;

But $A_s V^2 = A_1 V_1 V$,

so that $2 A_x V^2 - A_1 V_1 V - A_1 V_1^2 = 0$,

and from this we can find V, A_s, and A_a.

For a nozzle 4¾ ins. in diameter these results are plotted in Fig. 12, taking the nozzle velocity at 750 ft. per second and numerical results are given in the attached table, in which A_a V

is also given (Table A). Now, $A_a V$ is area in square inches of air multiplied by velocity in feet per second and this quantity for an opening of 80.72 sq. ins. is given, for different vacua, in Table B. Table C gives the velocity at which various mixtures of steam and air would have to flow at different vacua to have sufficient kinetic energy to restore them to atmospheric pressure.

Let us assume a vacuum of 5 ins. Table B shows that the quantity of air admitted through the opening is 11,700, Table A shows that this amount of air is entrained in the jet at 38 ins. from the nozzle and that the velocity is then 274 ft. Table C shows that this velocity is sufficient, as only 198 ft. is required with that mixture.

Here enters a condition that we do not know. While the mean velocity of the jet would be 274 ft., the velocity of the center is greater and of the edge less. We do not know what the ration between them is, although Figs. 7, 8, 9 show that the velocity rapidly equalizes as the nozzle distance increases; it

TABLE A.

Dis. from nozzle.	Diam. of jet.	Mean velocity V.	Area of jet A_x.	Area of steam A_b.	Area of Air A_a.	A_a v.
6.4	5¾	582	26	22.7	3.3	1,920
12.8	6¾	476	35.7	27.7	8	3,360
19.2	7¾	402	47	32.8	14.2	5,700
25.6	8¾	348	60	37.9	22.1	7,700
32.0	9¾	306	74.5	43	31.5	9,650
38.4	10¾	274	90	48	42	11.500
44.8	11¾	248	107	53	54	13,400
51.2	12¾	224	128	59	69	15,450
57.6	13¾	206	149	64	85	17,500
64.0	14¾	191	170.5	69	101.5	19,400

TABLE B.

Volume in square inches, one foot long of air that will flow per second through aperture 80.72 sq. ins. area, into receiver at lower pressure.

Vacuum, inches of water.	Volume per second.	Vacuum inches of water.	Volume per second.	Vacuum inches of water.	Volume per second.
1	5,250	3	9,150	5	11,700
2	7,420	4	10,500	6	12,800

TABLE C.

Velocity of flow from atmospheric pressure, to lower pressures for mixtures of steam and air.

Composition of Mixture.

Vacuum, inches of water.	Air / Steam / Air only.							
	Air	22	31.5	42	54	69	85	101.5
	Steam	38	43	48	53	59	64	69
	Air only.							
1	65	95	91	88	85	84	83	81
2	92	135	129	125	121	119	117	115
3	113	165	159	154	148	147	144	142
4	130	190	183	177	171	169	165	163
5	145	212	204	198	191	188	185	182
6	159	232	224	217	209	206	203	199

is, however, always less than the mean velocity. Why does this jet not go on entraining air and produce a higher vacuum? To obtain a 6-in. vacuum it would have to entrain a volume of about 12,800, corresponding to a nozzle distance of 44.8, and the mean velocity would have dropped to 248. The velocity necessary to restore the gas mixture to atmospheric pressure at the top of the stack is 209 ft. per second or 84 per cent. of the mean velocity of the jet and it can be safely said that the edge of the jet does not move at that velocity.

If conditions are such that the jet tries to take up more air part of it will not pass out to the atmosphere, but it will simply form a jacket around the jet, allowing the center portions with sufficient energy to pass out through the stack. Also note that 5 ins. is very closely the vacuum found in the Hanover test under these conditions. Now I certainly do not want to make facts fit into a theory, but considering the roughness of these calculations, there is something convincing about the corelations of these figures, and if facts would fit calculations upon generally accepted theories as closely it would be a great comfort to us all.

(To be continued.)

In drying locomotive sand by means of coils of steam pipes the pipe joints need to be kept tight or the leakage of steam will make more moisture than the dryer will be able to take out. Several examples of carelessness in this respect have been noticed in a recent examination of a number of sand houses built in connection with modern locomotive terminals.

M. C. B. DRAFT-GEAR TESTS.

A circular has been issued by the secretary of the M. C. B. Association to members of the association, and manufacturers of draft gear, outlining the plan of the committee on draft-gear tests. The committee has omitted all reference to road tests in the circular, the purpose being to first make drop tests, together with tensile and compressive tests, and afterward to take up different questions that require other methods of testing. To aid in this work Purdue University, through Professor Goss, has given the association the use of the Purdue 300,000-lb. capacity tensile and compression testing machine, and the Pennsylvania Railroad, through Mr. W. W. Atterbury, General Superintendent of Motive Power, has given the use of its drop-testing machine at Altoona, Pa. The general plan of the tests is therefore to show the relative standing of the different constructions under steady pulls and under shocks. The manner of testing is shown by engravings in this carefully-prepared circular, a copy of which can be procured from the secretary at No. 667 Rookery Building, Chicago, Ill.

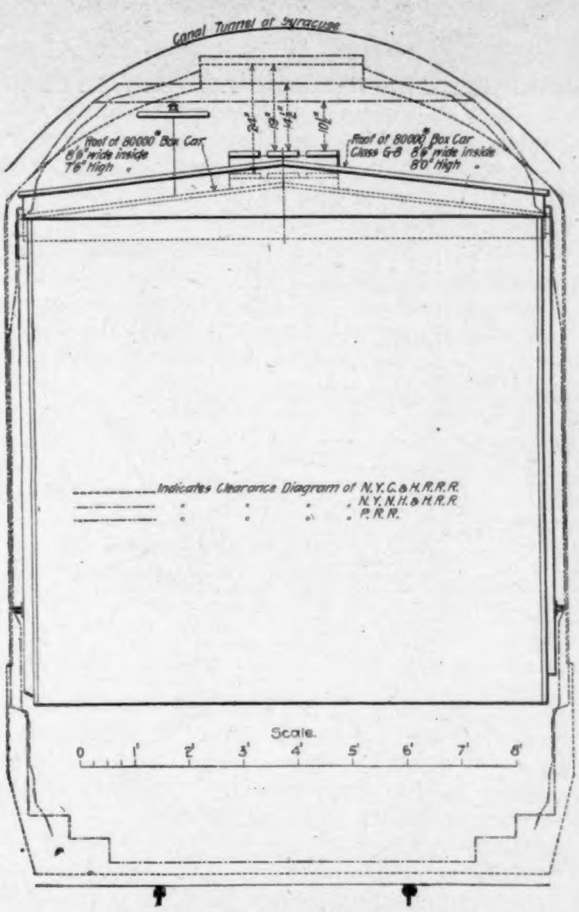
The market for new cars and locomotives is remarkably active at this time. The Pennsylvania Railroad Company has placed orders with three car manufacturing companies for an aggregate of 12,000 cars. Of this immense order 11,500 are to be 100,000 lbs. capacity, and the remainder are refrigerator cars. Included in the list are 6,000 steel gondola coal cars and 1,000 box cars with steel underframing, built to the standard dimensions of the American Railway Association. All of the other cars have steel underframes. The finished locomotives turned out last month by the American Locomotive Company numbered 167, or a rate of 2,000 engines a year. The Baldwin and Rogers Locomotive Works are equally busy, and all have booked sufficient orders to keep the plants running to their utmost capacity well into next summer. Since the above was written we learn of an order for 4,000 more cars by the Pennsylvania.

Mr. George R. Henderson, Assistant Superintendent of Machinery of the Atchison, Topeka & Santa Fe, has been appointed Superintendent of Machinery to succeed Mr. John Player, effective January 1. Mr. Player retires from active service at his own request, because of ill health, and will continue with the company as Consulting Superintendent of Machinery. He has held the position of Superintendent of this department since 1890, when he left the Wisconsin Central for this position. Mr. Player has had a long record of high standing. Mr. Henderson, who is well known to our readers for his comprehensive command of motive power subjects, is one of the youngest men to be called to such an important position on an American railroad. He began with a technical education, followed by a three years' apprenticeship on the Pennsylvania at Altoona. After serving six years as a draftsman and assistant chief draftsman at Altoona he went to the Roanoke Machine Works as Assistant Superintendent. He afterward became Mechanical Engineer of the Norfolk & Western at Roanoke, and was called to the Schenectady Locomotive Works in March, 1899. Soon after this he was appointed Assistant Superintendent of Motive Power of the Chicago & Northwestern, a position which he filled with credit. Mr. Henderson was appointed Assistant Superintendent of Machinery of the "Atchison" last June, and at once showed his ability to take charge of the department. He is an example of the combination of technical engineering training with active experience, and has made an enviable reputation by his writing as well as his railroad work. He has contributed many very valuable papers and discussions to the Master Mechanics' Association, the American Society of Mechanical Engineers, and to the American Engineer and Railroad Journal.

CLEARANCES AND THE M. C. B. STANDARD BOX CAR.

Elsewhere in this issue the general features of the subject of the standard box car are discussed, and, by courtesy of Mr. A. M. Waitt, of the New York Central, we are permitted to present a comparison of clearances of several prominent roads which bears on an important feature of this question.

On many roads the clearances are sufficient to permit of using the recommended standard height of 8 ft. with no difficulty whatever, but on three roads, at least, the New York Central, New York, New Haven & Hartford and the Pennsylvania, the clearances over the running board are too small for comfort.



The Standard Box Car and Clearances.

It is understood that these clearances on these roads constituted the chief objection to the 8-ft. car, but, notwithstanding the difficulties, the standard has been adopted and it remains for them to be overcome. On the Pennsylvania there is trouble also at the eaves, but it is understood that the clearances at this point may be somewhat enlarged on that road by work which is now under way.

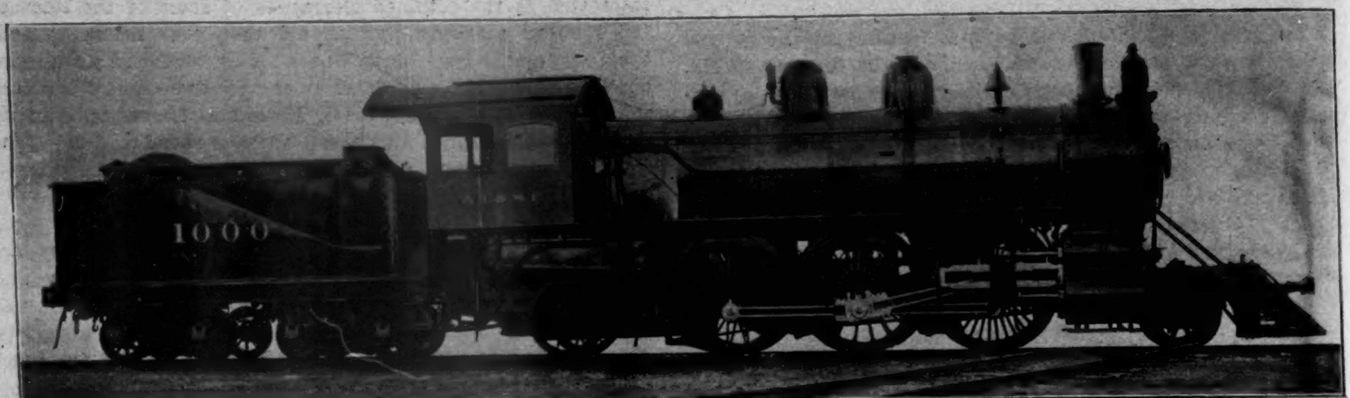
A glance at the comparative diagram, reproduced by permission of Mr. Waitt, will show what this problem amounts to. The car roof shown in solid lines was drawn to represent an 8-ft. car, and it is apparent that it exceeds the Pennsylvania clearances at the eaves and that it leaves but 19 ins. clearance over the running board. This car can run over the New York, New Haven & Hartford, but on one of the divisions its brake staff would just clear and brakemen would have but 10½ ins. over the running boards. On the other division they would have but 14½ ins. Mr. Waitt does not consider anything less than 20 ins. as safe, and on a lot of new cars for which the drawings are now under way, he has decided on a design which includes the standard interior dimensions and which, by careful attention to the roof at the eaves, comes within the Pennsylvania clearances and leaves 20 ins. over the running board on the New York Central.

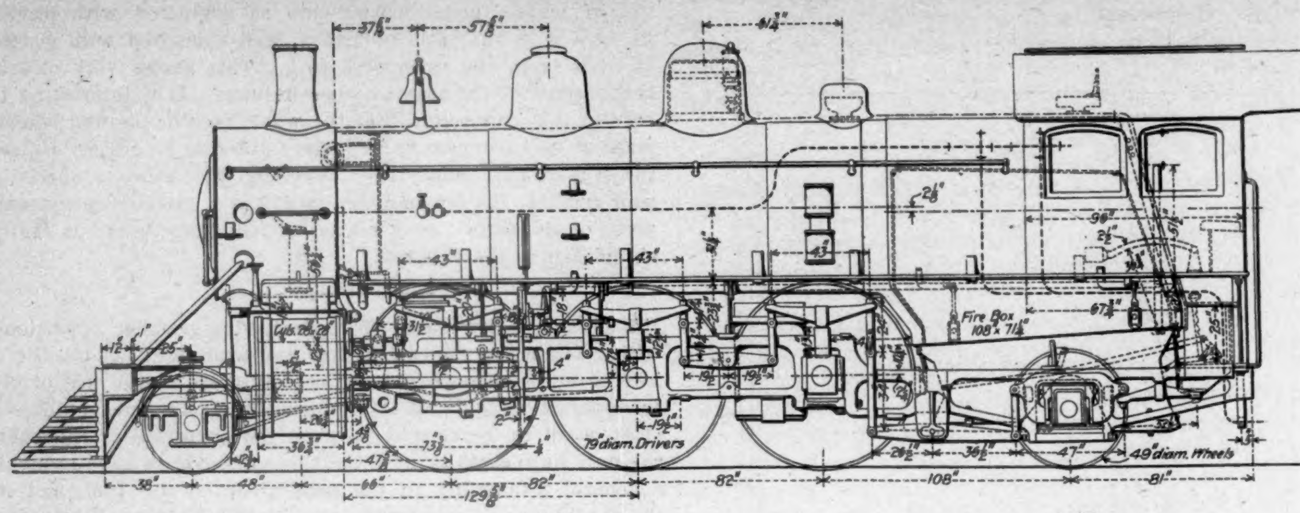
Western roads whose cars never come East are not specially interested in the confined clearances of some of the lines on the Eastern seaboard, but should they ever desire to send their equipment over these lines it may be found advantageous to consider the clearances in the construction of the cars, so that they may go anywhere. From this discussion it seems possible to accomplish this result without sacrificing any principle of construction, and to show that this may be done is the object of this article.

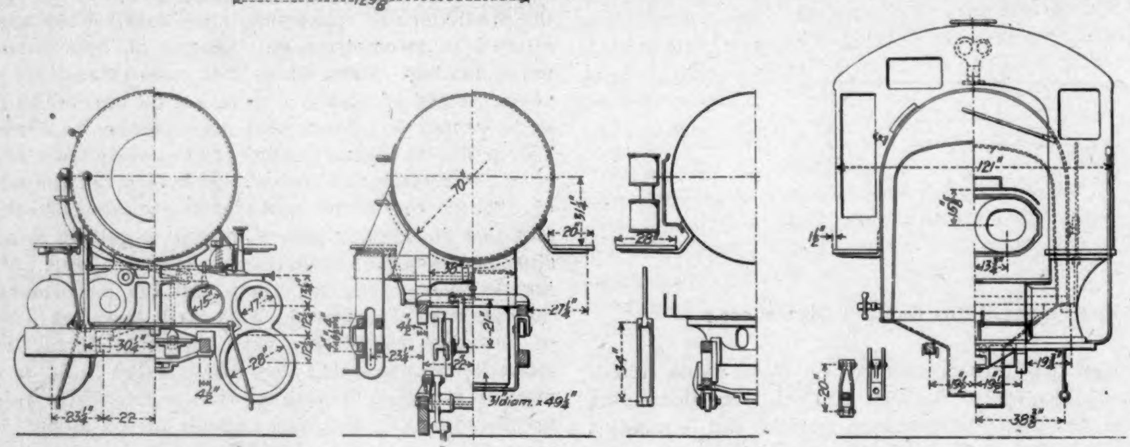
That higher grade car wheels for large capacity cars are necessary is clear to a correspondent of the "Railway and Engineering Review," who quotes the experience of an important road as follows: "The road in question has a variety of freight cars of all capacities and was one of the first purchasers of steel cars of 100,000 lbs. capacity. An investigation of the wheel records recently ordered shows that the failure of wheels under 100,000-cars as compared with 60,000-lb. cars is in the ratio of 3 to 1; and compared with 40,000-lb. cars is in the ratio of 5 to 1. This shows very clearly the relation of the load to wheel failures. It is interesting to note in this connection that the wheel records showed wheels made at various times by over sixty different foundries. Unless the wheels used under the 100,000-lb. cars were of specially poor quality, the comparative record is a fair indication and proof of the facts. As a matter of fact their record is really an epitome of the situation."

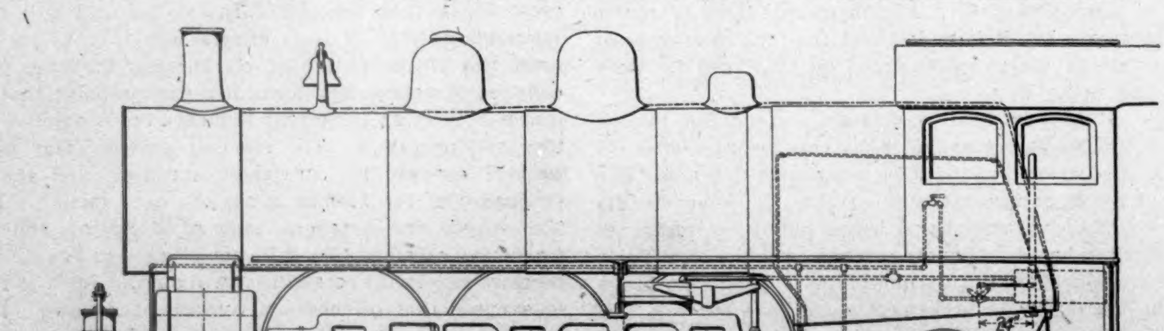
Except in a few cases of roads having peculiar conditions with reference to the cost of coal and availability of oil, there has never been more than a local interest in the use of oil for locomotive fuel. What influence the phenomenal discoveries of oil in Texas will have on the operation of railroads can only be guessed at now, but these discoveries have brought a general awakening to the possibilities of oil fuel, and if the predictions of cheap supply are fulfilled the application of oil fuel to locomotives will assume an importance which it never has had. Even where it is most extensively used it has never seemed advisable to fit up for oil burning in such a way as to render it inconvenient or expensive to return to coal. This is due to the uncertainty of the continuance of the supply, or of the relations of cost which have given the advantage to oil. There can be no doubt of the success of oil, or of the fact that its employment will tend to relieve locomotive designers of some of their present burdens. But notwithstanding its success it seems likely that the performance with oil may be greatly improved. This far it has always been burned in fireboxes which were built for coal. If the Texas fields affect the oil market as they are expected to do, it will pay to make a study of the subject with reference to the design of fireboxes so that they may be built for oil alone. It does not seem likely that the best furnaces for coal will be equally favorable to oil. If it is unnecessary to consider the grate area, and if the design of oil burning fireboxes becomes a question of volume and form, it seems probable that oil burning may exert an important influence on locomotive construction and operation. The staybolt problem may perhaps be avoided entirely by corrugated furnaces, and the physical endurance of the fireman drops out as a factor in operation. This fuel is now a general topic of discussion, and many are wondering whether they will not be able to use it. If its use becomes general its possibilities will expand, for it is reasonable to suppose that oil needs a furnace of its own. In the oil belts, at least, real oil-burning locomotives may be expected as a development of the near future.

The consumption of fuel oil by the railroads of California is at present at the rate of 3,000,000 barrels per year, and the total output of California wells is 8,000,000 barrels per year, according to a recent published statement by Dr. C. T. Deane, Secretary of the California Petroleum Miners' Association.









Showing Traction Increaser.

Prairie Type Passenger Locomotive with Traction Increaser, Largest Passenger Locomotive Ever Built—Atchison, Topeka & Santa Fe Railway.

J. PLAYER, *Superintendent Machinery.* G. R. HENDERSON, *Assistant Superintendent Machinery.*

PRAIRIE TYPE PASSENGER LOCOMOTIVES.

Largest Ever Built.

With Traction Increaser.

Also Ten-Wheel Passenger Locomotives.

Atchison, Topeka & Santa Fe Railway.

Built by the Baldwin Locomotive Works.

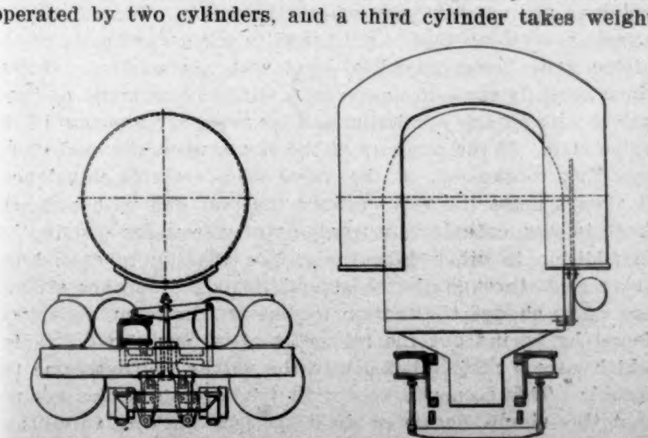
Forty-five of the remarkable engines illustrated by these engravings are being built by the Baldwin Locomotive Works for the Atchison, Topeka & Santa Fe for working passenger trains over the 16-degree curves and grades of 184 ft. per mile, such as occur between Albuquerque and La Junta. These engines have about 15 per cent. more tractive power than the most powerful previous design on this road. They weigh 190,000 lbs. and have 3,738 sq. ft. of heating surface, these figures being larger than have been used in passenger locomotives. The weight on driving wheels is 135,000 lbs., the same as the Lake Shore Class J prairie type, illustrated in the March, 1901, issue of this journal, page 69. In comparing the heating surface and total weight of a number of recent designs, these Atchison engines head the list with reference to the total weight divided by the heating surface, as indicated in the following table:

Name of road.	Engine No.	Total weight.	Total heating surface.	Total weight divided by heating surface.
Atchison	1,000	190,000	3,738	50.08
N. Y. Central	2,980	176,000	3,505	50.20
Lake Shore	650	174,500	3,343	52.18
C. & N. W.	1,015	160,000	3,015	53.06
L. V.	681	225,082	4,105	54.83
B. & O.	1,450	150,000	2,663	56.50
B., C., R. & N.	77	158,600	2,551	62.17
C., B. & Q.	1,591	159,000	2,500	63.60
Can. Pacific	209	159,000	2,401	66.00
Penn.	820	159,000	2,401	66.00

Note.—All are passenger locomotives except that of the Lehigh Valley.

These engines will be used on the most important trains, and will undoubtedly greatly reduce the amount of mountain pusher service. Among the interesting details may be noted the use of compound cylinders, 74-in. driving wheels, wide grates, 19-ft. tubes, inside journals for the trailing wheels, bent motion bars, with rockers close to the steam chests, sloping back boiler head and front water leg, plate firebox supports, 9 by 12-in. main driving journals, 10 by 12-in. journals for the other driving axles, and one of the lot of 40 engines is fitted with a traction increaser.

This is the first application of which we have record of a traction increaser to a large six-coupled engine. It is intended to increase the weight on driving wheels from 135,000 to 160,000 lbs., and for this type of engine, with divided equalization, it is necessary to also divide the traction increaser. At the rear end the equalizer fulcrums are changed by a cross-bar operated by two cylinders, and a third cylinder takes weight from the front truck by means of the lever shown. This is a bold plan, which will be watched with interest. Our engraving shows the arrangement of piping, whereby a valve controlling the application of the traction increaser is operated by the reverse lever, so that it may not be applied except when working at long cut-offs. These engines have a tractive power of 27,500 lbs., which is increased by the traction increaser to about 32,000 lbs. by the use of live steam in the low-pressure cylinders.



Front and Rear Elevations of Engine, Showing Arrangement of Traction Increaser Cylinders.

There is work for such engines to do on this road, where even in the comparatively level districts double-heading is frequently necessary in bad weather. This design is a part of a thoroughgoing plan of increasing the capacity of locomotives on this road, which is sure to merit the attention of all who are concerned in improving locomotive practice. The leading dimensions of these engines are recorded in the following table:

Compound Prairie Type Locomotive, Atchison, Topeka & Santa Fe Railway.

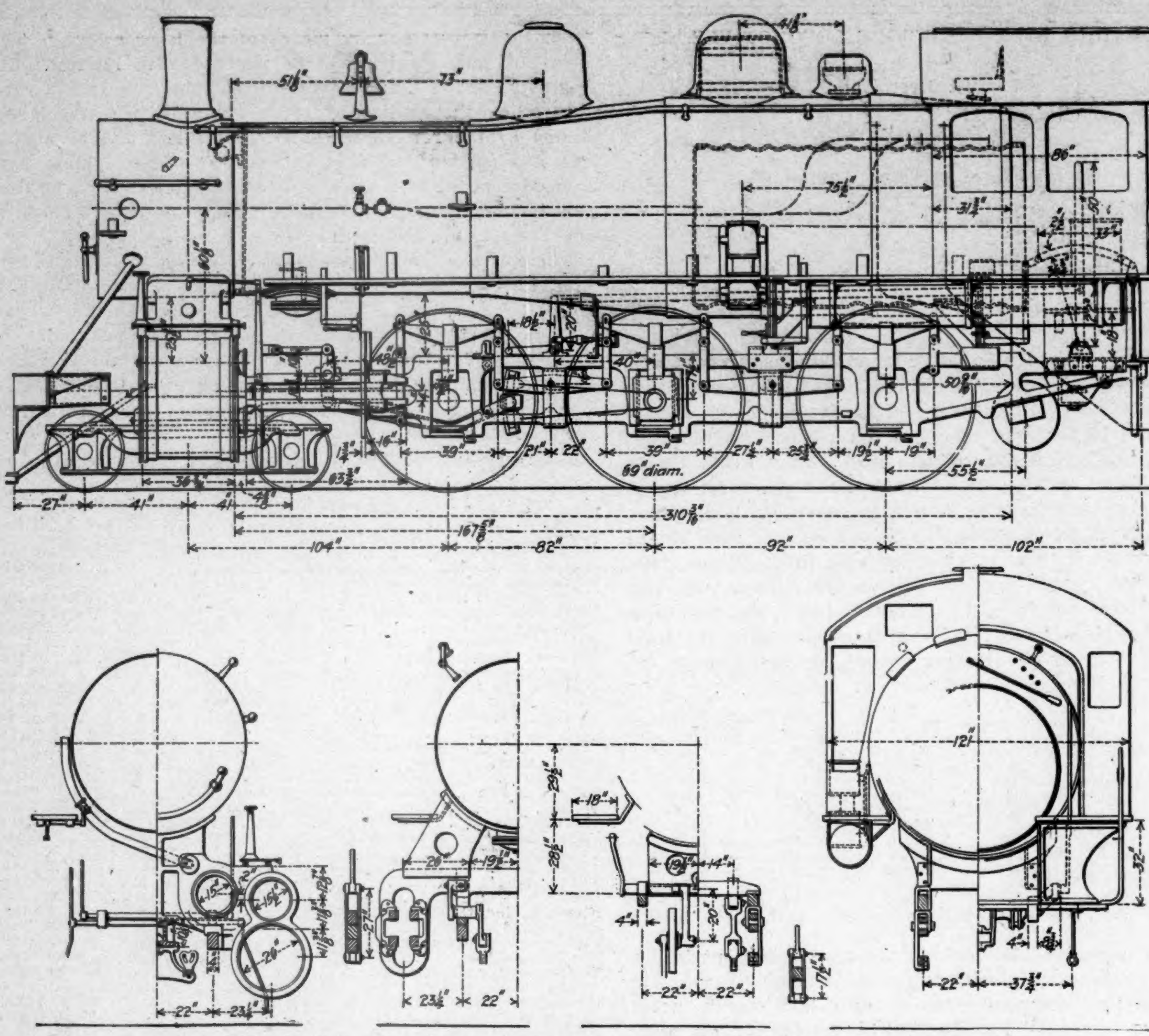
General Dimensions.

Gauge	4 ft. 8½ ins.
Kind of fuel to be used	Soft coal
Weight on drivers	135,000 lbs.
Weight on leading truck wheels	25,000 lbs.
Weight on trailing truck wheels	30,000 lbs.
Weight, total	190,000 lbs.
Cylinders, diameter	17 and 28 ins.
Cylinders, stroke	28 ins.
Drivers, number	6
Drivers, diameter	79 ins.
Steam pressure	200 lbs.
Heating surface, tubes	3,543 sq. ft.
Heating surface, fire-box	195 sq. ft.
Heating surface, total	3,738 sq. ft.
Grate area	53.5 sq. ft.
Wheel base, total, of engine	32 ft. 2 ins.
Wheel base, driving	13 ft. 8 ins.
Length over all, engine	46 ft. 3 ins.
Length over all, engine and tender	69 ft. 7 ins.
Height, center of boiler above rail	112 ins.
Boiler, type of	Straight top
Boiler, diameter of barrel	70 ins.
Tubes, number	318
Tubes, diameter	2¼ ins.
Tubes, length	228 ins.
Fire-box, width	71¼ ins.
Fire-box, length	108 ins.
Fire-box, depth front	76⅛ ins.
Fire-box, depth back	67⅝ ins.
Tender, weight	112,000 lbs.
Tender, water capacity	6,000 gals.
Tender, coal capacity	10 tons.
Wheel base, total (engine and tender)	57 ft. 9 ins.
Height of stack above rails	15 ft. 6 ins.
Drivers, material of centers	Cast steel
Truck wheels, diameter	Front, 42¼ ins.; Back, 49 ins.
Journals, driving axle, size	Main, 10 x 12 ins.; Others, 9 x 12 ins.
Journals, truck axle, size	Front, 6½ x 12 ins.; Back, 7½ x 12 ins.
Main crank pin, size	7 x 7 ins.
Piston-rod, diameter	Hollow, 4½ ins.
Kind of piston-rod packing	Metallic
Main rod, length center to center	7 ft. 8¾ ins.
Steam ports, circular, length	34 ins.
Steam ports, width	1½ ins.
Exhaust ports, circular, length	34 ins.
Exhaust ports, width	4½ ins.
Bridge, width	3 and 2¾ ins.
Valves, kind of	Balanced piston, 15 ins. diam.
Valves, greatest travel	5½ ins.
Valves, outside lap	H. P., ⅞ in.; L. P., ¾ in.
Valves, negative inside lap	H. P., ¼ in.; L. P., ⅜ in.
Valves, lead in full gear	H. P., 0 in.; L. P., ⅛ in.
Boiler, material in barrel	Steel
Boiler, thickness of material in barrel	11/16 and ¾ in.
Seams, kind of horizontal	Butt jointed, double covering, strips; sextuple riveted
Seams, kind of circumferential	Double
Thickness of tube sheets	Both ½ in.
Thickness of crown sheet	9/16 in.
Crown sheet stayed with	1 in. radial stays
Dome, diameter	31½ ins.
Fire-box, material	Steel
Fire-box, thickness of sheets	Crown, sides and back, ⅜ in.
Fire-box, brick arch	Yes
Fire-box, water space, width	Front, 4½ ins.; sides, 4 ins.; back 4 ins.
Grate, kind of	Rocking, in four sections
Smoke-box, diameter	72⅛ ins.
Smoke-box, length	72 ins.
Exhaust nozzle	Single
Exhaust nozzle	Permanent
Exhaust nozzle, diameter	4½, 4¾ and 5 ins.
Exhaust nozzle, distance of tip below center of boiler	6½ ins.

TEN-WHEEL OIL-BURNING PASSENGER LOCOMOTIVE.

With Vanderbilt Boiler.

These engines are also heavy, and compounds. They will burn oil, and for this fuel the Vanderbilt firebox seems to be specially well adapted. The fireboxes are 10 ft. 11 ins. long,



Ten-Wheel Oil Burning Passenger Locomotive—Atchison, Topeka and Santa Fe Railway.

with the necessary brick arches for oil burning. The boilers are of the wagon-top type and will carry pressures of 200 lbs. The heating surface is 2,946 sq. ft., and the engines will weigh 175,000 lbs. These engines will be used on districts which are within reach of the California and Texas oil regions. The chief dimensions of these engines are as follows:

Ten-Wheel Passenger Locomotive, Atchison, Topeka & Santa Fe Railway.

General Dimensions.

Gauge	4 ft. 8½ ins.
Fuel	Oil
Weight in working order	175,000 lbs.
Weight, total engine and tender	285,000 lbs.
Weight on driving wheels about	135,000 lbs.
Weight on front truck	40,000 lbs.
Wheel base, driving	14 ft. 6 ins.
Wheel base, engine total	26 ft. 7 ins.
Wheel base, total engine and tender	56 ft. 6½ ins.

Cylinders.

Diameter of cylinders	H. P., 15½ ins.; L. P., 26 ins.
Stroke of piston	28 ins.
Valve, boiler	Balanced piston
Boiler, diameter	66 ins.
Thickness of sheets	⅝ and 13/16 ins.
Working pressure	200 lbs.
Fire-box	Vanderbilt
Material	Steel
Diameter	63⅝ ins.
Thickness of sheets	Sides, ¾ in.; back, ¾ in.; crown, ¾ in.; tube sheet, ½ in.
Tubes, material	Iron
Tubes, number of	360
Tubes, diameter	2 ins.
Tubes, length	15 ft. 0 in.
Heating surface, fire-box	135 sq. ft.
Heating surface, tubes	2,811 sq. ft.
Heating surface, total	2,946 sq. ft.
Grate area	No

Wheels, Etc.

Diameter of driving wheels outside of tire	69 ins.
Journals	9 x 12 ins.
Diameter engine truck wheels	30 ins.
Journals	6½ x 10½ ins.

Tender.

Wheels, diameter	34¼ ins.
Journals	5 x 9 ins.
Water capacity	6,000 gals.
Oil capacity	2,200 gals.

Piston valves have made many friends and are highly spoken of by those who have had wide experience with them, but opinions are not yet unanimously favorable. This is true of almost everything that is good, and in the development of the piston valve some difficulties have been encountered. One of them recently came to notice on a road having many of these valves with outside admission and the usual arrangement of the valve stem. If the pressure of the steam upon the area corresponding to the end of the valve stem remains unbalanced it always urges the valve toward the rear and with sufficient force to give considerable trouble with the steam distribution in addition to other difficulties. Not wishing to extend the valve stem through the chest and introduce another stuffing box or to change the motion for inside admission, relief was found by boring out the rear valve bushings about 3/16 in., which gave a perfect balance to the valves and overcame the trouble. This seems to be almost trivial, but we are assured that this simple device produced perfect working valves and entirely changed the opinions of the engine men. Others may have had this difficulty without thinking of this simple remedy.

NEW FUEL FOR SWEDISH RAILROADS.

Sweden imports yearly large quantities of coal and coke, and this trade is increasing steadily, in pace with the industrial activity and the building of new railroads. Several millions of dollars are annually paid out to foreign countries for fuel. The managers of the State railroads have been instructed to make trials of peat, peat charcoal, and peat briquettes as fuel for locomotives. The intention is to construct a special locomotive to be used in these experiments, and if they are successful other engines will undoubtedly be built, because peat is abundant in that country. The navy and the State railroads have also tried to use Swedish coal, but without much success; the efforts will be continued, however. Consul Bergh reports from Gottenburg as follows:

"In the new briquette factory at Elmhult, belonging to the State, experiments will be made this fall in the production of a cheap and practical fuel for Swedish railroads. In locomotive furnaces Swedish coal cannot be used alone, because it contains too much scrap and incombustible substances, which are not consumed, but form refuse and ashes. It must, therefore, be mixed with English coal, but this is becoming more and more expensive. The possibility of using Swedish coal alone is therefore ideal, and the above-mentioned factory has been built, to be employed in the attempts to make or refine Swedish coal into a good fuel. The factory will operate according to a German patented method, and has been put up under the supervision of a German. It will be started this fall, and the work will continue night and day. It is calculated that the output will be 36 briquettes per minute—that is, 51,840 per 24 hours, or 15 carloads of 10,000 kilograms per car. Experiments will first be made with 40 carloads of Swedish coal of the lowest grade.

Every little while the North German Lloyd Steamship Company adds to its already large number of floating palaces a steamer which shows in every way the progress in German naval architecture, including mechanics, art and science. Everything that is new in the way of equipment, such as electric heating, lighting, fans and wireless telegraphy, are used for the comfort and convenience of passengers. The latest production of the Vulcan Shipbuilding Company, Stettin, Germany, is the steamer "Bremen" of the North German Lloyd. This vessel was damaged in the terrible Hoboken fire of June 30, 1900. She is now in service again, with no sign of the old ship remaining. She has been lengthened 25 ft. to add more boiler power, and from the hull up the ship is entirely new. Not alone is the floating equipment of the North German Lloyd Company the most improved, but its docks at Hoboken, N. J., when completed, will be altogether the best on this or the other side of the Atlantic. The roofs, floors, sides, window frames and, in fact, every part of the docks, will be of steel, concrete or masonry. The building connecting the ends of the piers on land will be two stories high, of the same construction, with a large promenade on the second floor for the use of patrons of the line. Passenger elevators will be used for the convenience of the public, and in addition there will be a number of large double staircases inside and outside of the building. These piers will be as nearly fireproof as it is possible to make them.

Vice-President Voorhees, General Superintendent Besler and half a dozen division superintendents of the Reading Railway, had a conference recently on the subject of establishing stations for the testing of air brakes. It is probable that plants will be located for this purpose in all the principal yards of the company, and that they will be erected as soon as the necessary machinery can be secured. In this way the same attention is to be given to freight and coal cars that is now given to passenger coaches.

FREIGHT CAR REPAIRS ARE INCREASING.

Freight car repairs are increasing in cost to an extent which has led, on a number of roads, to an investigation of the causes. They are attributed chiefly to the rough handling of freight equipment, which is a result of the introduction of automatic couplers. This is a matter of grave importance and it will require action. Either the rough handling must stop or the car construction must be such as to provide for it. Probably it cannot be stopped entirely, because in busy seasons there is not time to be gentle with cars, but abuse can unquestionably be regulated. There are several ways, however, to improve the situation. The maintenance of air brake hose is beginning to be appreciated as being enormously more expensive than it ought to be. This is due to two, and, perhaps, more, causes. There seems to be an increasing tendency toward a general practice of not uncoupling the hose when cars are uncoupled, thus submitting the hose to severe strains which were intended to occur only in cases of emergency. The other clause, and it is closely related to this practice, is carelessness in maintaining the M. C. B. standards with reference to the location of train pipes and angle cocks. The second cause aggravates the first, because with properly located pipes and angle cocks the pulling apart of the couplings would do far less damage to the hose. The Car Foreman's Association of Chicago has done good service in this connection by revealing the defective condition found in a lot of 100 cars recently examined in one of the Chicago yards. This examination gave the following results:

	Per cent.
Angle cocks 13 ins. from center line of car	33
Angle cocks more than 13 ins. from center line of car	58½
Angle cocks less than 13 ins. from center line of car	8½
Angle cocks set at the proper angle	30½
Vertical angle cocks	39½
Turned toward track 10 degrees or over	12½
Turned toward proper position 10 to 20 degrees	17½
Total out of position	69½
Distance from center of train pipe to center line of coupler.	
Correct position	48
Below center line of coupler	43½
Above center line of coupler	8½
Condition of pipe brackets:	
Proper position	85
Bent outward	15
Condition of train pipe:	
Proper position	94
Train pipe shifted	6

These cars were taken in regular order on the tracks with few exceptions. Cars which were examined at other times were in much worse condition than those shown in the report. These may appear to be trifles, but the serious consequences of break-in-twos because of burst hose connections is sure to bring the subject before the managements of railroads before long. This feature of the trouble is far more serious than the cost of hose replacements, important as they are.

AIR-BRAKE EQUIPMENT OF FREIGHT CARS AND LOCOMOTIVES.

The American Railway Association Committee on Safety Appliances reported at the recent St. Louis meeting the following statement of the equipment of freight cars and locomotives with air brakes, including July 1, 1901:

Freight cars in service	1,368,458
Fitted with air brakes	1,012,390
Engines in service	35,025
Equipped with power brakes	34,637

New equipment, other than passenger, under contract or construction:

Freight cars to be fitted with air brakes	52,623
Freight cars not to be fitted with air brakes	0
Engines to be equipped with power brakes	1,296
Engines not to be equipped with power brakes	0

A contract has been placed for sleeping cars to run on the electric line between Cincinnati and Columbus, O.

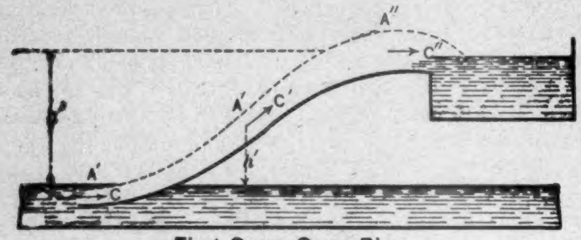
THEORY OF LOCOMOTIVE WATER-SCOOPS.

By Professor I. P. Church, Cornell University.

For simplicity it will be assumed that the result is the same if the locomotive is stationary, while the main trough of water and its contents move underneath it with a velocity (uniform) equal to that of the locomotive in the actual case. Let this velocity be denoted by c.

First Case.—Open Trough.

Let the scoop and channel be an open trough, so that the depth of the stream of water proceeding upward along it is



First Case—Open Pipe.

free to adjust itself in accordance with the dynamic relations of the flow.

It is well known that if a block be started with a velocity, c, along a smooth and fixed guiding surface inclining upward, it will not come to rest until a vertical height $h = \frac{c^2}{2g}$ (g being the acceleration of gravity, = 32.2 for the foot and second) above the initial point has been reached; also that at a height h' (less than h) above the starting point the velocity will have diminished to a value, c', satisfying the relation

$$\frac{c'^2}{2g} = \frac{c^2}{2g} - h' \qquad \text{(1)}$$

In the case of a great number of successive "blocks," or water particles, when an even or "steady" flow takes place up the open trough, the effect of a diminished velocity is to produce a thickening, or increase of depth (if width of trough is uniform) of the stream in accordance with the law

$$F'c' = Fc \qquad \text{(2)}$$

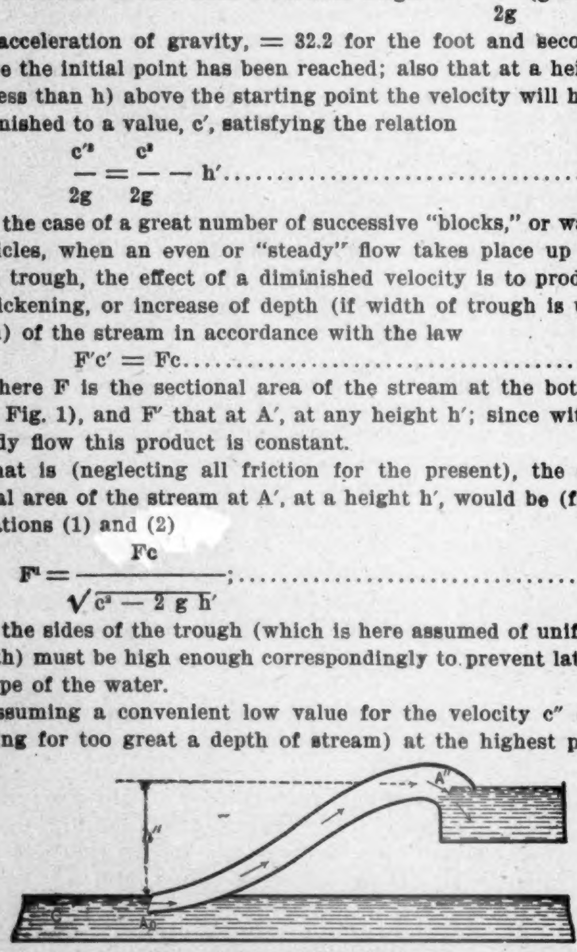
Where F is the sectional area of the stream at the bottom (see Fig. 1), and F' that at A', at any height h'; since with a steady flow this product is constant.

That is (neglecting all friction for the present), the sectional area of the stream at A', at a height h', would be (from equations (1) and (2)

$$F' = \frac{Fc}{\sqrt{c^2 - 2gh'}}; \qquad \text{(3)}$$

and the sides of the trough (which is here assumed of uniform width) must be high enough correspondingly to prevent lateral escape of the water.

Assuming a convenient low value for the velocity c'' (not calling for too great a depth of stream) at the highest point



Second Case—Closed Pipe.

A'', the greatest height to which the water could be raised, with the given velocity c at A, would be h''; to be computed from the equation

$$h'' = \frac{c^2}{2g} - \frac{c''^2}{2g} \qquad \text{(4)}$$

Friction, however, modifies these results somewhat, and can be provided for in the formula by introducing a "loss of head" (depending on the square of the velocity nearly and also on the size of the section and the depth) for each small length along the trough. This would complicate the formula extremely, so that it is better to introduce a single loss of head of the form $\frac{m}{2} \cdot \frac{c^2 + c''^2}{2g}$, making equation (4) now read

$$h'' = \frac{c^2}{2g} - \frac{c''^2}{2g} - \frac{m}{2} \cdot \frac{c^2 + c''^2}{2g} \qquad \text{(5)}$$

The number, m, would have to be determined by experiment in each case. By reason of friction the maximum possible value of h'' would be quite a little smaller than that obtained from equation (4).

It is evident that the tip of the scoop at A must not be permitted to dip too far below the surface; i. e., too great a value must not be given to the sectional area, F, of the stream at A, otherwise the sections above, all of which are larger than F, would become too great, and the water would overflow the sides. For example, if the tip of the trough is 12 ins. wide at A and dips 1 in. below the surface of the water, we have F 1-12 of a square foot, so that if c is twelve times c'', the value of F'' will be 1 sq. ft.; that is, the depth of the stream at A'' would be 1 ft., for the same width of trough.

The quantity of water delivered per second would be Q = Fc (in cubic feet per second, say; if c is feet per second and F expressed in square feet). Vice versa if h'' is given as well as c and F, c'' becomes known from (5) and the corresponding area F'' can then be computed from Fc = F''c'', and its value compared with the capacity of the trough at A''.

Second Case.—Closed Pipe.

Here, a gradual increase of section (and consequent gradual diminution of velocity, assuming the pipe to flow full) should be provided, in the direction of the flow of the water; just as is done on the downstream side of the throat of a venturi meter, and also in the design of the delivery tube of a steam injector. In the venturi meter and in the injector tube the object is to enable the stream, which in the "throat" is at high velocity, and low pressure, to make its way by gradual reduction of velocity into a region where the pressure is much greater; and in the present apparatus a similar design will enable the stream to flow into a region of increasing altitude with gradually diminishing velocity. If the sectional area of the pipe were kept uniform the capacity of the device would be limited; though if the end of the pipe were dipped but slightly below the water surface a stream might be lifted which would not fill the pipe, the latter becoming in that case an open trough.

Since with a closed pipe of fixed dimensions the stream of water is no longer free to vary its own sectional area, but must take that of the pipe, assuming the pipe to have full sections at all points, the velocity of the water in the "throat" or narrow tip at A_0 has a value c_0, in any given case, not necessarily equal to that, c, of the main body of water approaching the locomotive.

Let us first assume, however, that c_0 equals c, in order to note the conditions that must be fulfilled for the attainment of such a result. Such being the case, the water in the throat will be under atmospheric pressure and that in the section at A'' is also, and in all cases, under atmospheric pressure. For the steady flow in the pipe from A_0 to A'', Bernoulli's fundamental theorem gives rise to the relation (see Fig. 2):

$$\frac{c^2}{2g} = h'' + \frac{c''^2}{2g} + m' \frac{c^2}{2g} \qquad \text{(6)}$$

in which c'' is the (slow) velocity of the water at A'' and m' is a coefficient whose value may vary from 0.10 to 0.50 (judging from results of experiments with pipes and venturi meters), the term $m' \frac{c^2}{2g}$ representing the "loss of head" occurring between A and A''. From this we obtain, after writing $c'' = \frac{Fc}{F''}$,

as the value of that particular velocity of the locomotive for which (with the given h″, and dimensions of pipe) the velocity

$$c = \frac{\sqrt{2gh''}}{\sqrt{1-\left[m^1+\left(\frac{F}{F''}\right)^2\right]}} \qquad \ldots\ldots\ldots\ldots 7$$

of the water through the tip would be equal to that of the locomotive over the track. In other words, no water would be thrown sideways by the advancing tip, and there would be less splashing.

For example, with $h'' = 15$ ft. and $F'' =$ eight times F, and $m' = 0.10$, we find this special value of c to be about 33 ft. per second (or some 22 miles per hour for the locomotive). If the locomotive has a less speed than that given by equation (7) (with the same h and dimensions of pipe, etc.), the water would simply form a standing column in the pipe, not reaching high enough to flow into the tank.

If the speed of the locomotive were greater than that given by (7) the stream of water would probably not fill the pipe completely, but simply flow along the lower part of each section as in an open trough, the section of the stream increasing with the altitude, as already shown, but not filling the pipe except near the tip, A_0.

VALVE MOTION AND STEAM DISTRIBUTION.

In an admirable paper on locomotive steam distribution, read recently before the Northwest Railway Club, Mr. H. T. Herr, Division Master Mechanic of the Chicago Great Western, gave an extended description of the effect of changing the valve functions, and discussed the most important present questions in valve setting and construction. His conclusions merit thoughtful attention, with special reference to that concerning double ported vales for high speed work. This subject is soon to be thoroughly investigated by practical experiment on a western road. The summary of his conclusions is as follows:

(1) The design of valve motion as a whole is as important as any other single element of the locomotive, and in its solution consideration should be given to the nature of the service to which the engine will ultimately be assigned, as outlined in the body of this paper.

(2) The distribution of steam at the probable running cut-off is most important for the proper action of the valve motion and its elements.

(3) The full gear adjustment should not be allowed to influence the setting of the valve, to the detriment of the running cut-off.

(4) A greater reduction of lead than is generally found in practice is advisable, as is also an increased outside lap and travel.

(5) Some form of double or multiple ported valve is valuable and should be used, especially in high speed work.

(6) The Zeuner and harmonic valve diagrams are material aids to the solution of all slide valve problems.

The Superintendent of Motive Power of one of the most prominent Western roads desires to be put in communication with young men who have recently graduated from mechanical engineering schools and wish to enter service as special apprentices. An opportunity is offered for gaining experience and for the preparation for promotion, for which this road offers unusually favorable opportunities. This is a case in which technical education is thoroughly appreciated and where ability is sure to be recognized. It seems strange, in view of the remarkable developments of the motive power situation, that the prominent roads are not overwhelmed with applications. Young men who are soon to graduate from their technical studies and who are attracted by the opportunity mentioned here, will be placed in communication with the officer referred to, through the editor of this journal.

COMPLETION OF THE SIBERIAN RAILWAY.

The Siberian Railway is almost completed, at a total cost of about $390,000,000. This road, of 5,542 miles, including its branches, traverses the most fruitful and comparatively populous part of Siberia and puts all Russia with her Siberian granaries and other productive powers in commercial intercourse with the countries of eastern Asia.

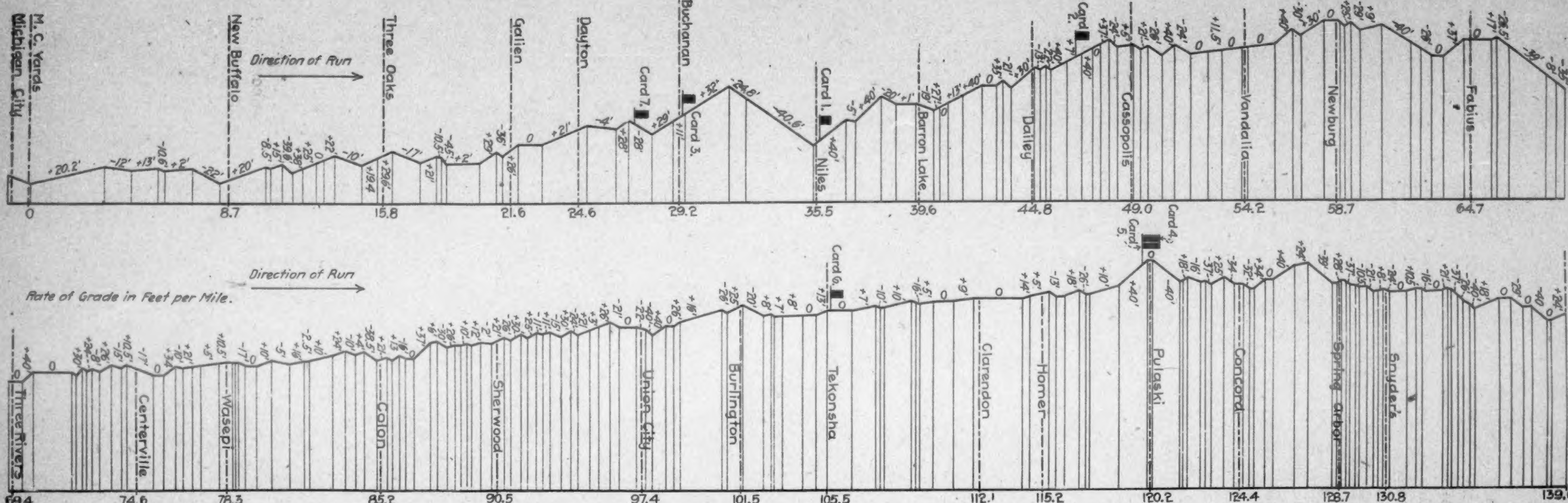
In selecting the shortest and most direct route from St. Petersburg, which is the western terminal, to Vladivostock, the eastern terminal, it was necessary to build more than 30 miles of bridges; the longest of these is over the Yenisei River, and is 2,940 ft. long, with spans measuring 490 ft. In spite of the difficulty of building a permanent roadway in a country so intersected by rivers, the Siberian Railway is unequaled in rapidity of construction. Work on this great transcontinental railway, which was constructed by Russians and with Russian money, began May 19, 1891, and by 1900 there had been built 3,375 miles of line, making an average of 375 miles a year.

Direct steam communication with only small gaps is now possible between the railways of Europe and Vladivostock on the Pacific coast. At this terminal a commercial port has been built in order to regulate trade with the countries of China and Japan. There is also an important branch of this railway reaching to Port Arthur on the Yellow Sea, and connecting with a regular service of steamers along the Pacific coast and the Sungari River, which flows through the most thickly populated and industrial part of Manchuria.

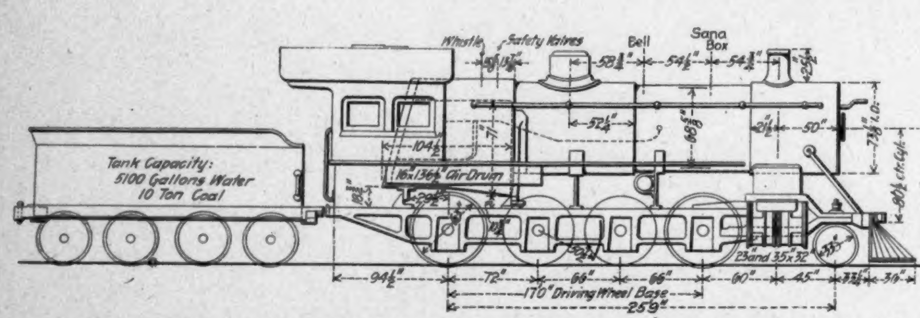
The passenger equipment of the road is constructed on the side corridor plan, and on account of the wide gauge track, the cars are more commodious than those of the European narrow gauge roads. The "train de Lux," which leaves Moscow for Irkutsh twice a week, is said to compare favorably with the limited trains of this country in accommodations, but not in speed. It is lighted by electricity, with both stationary and portable lamps, and each apartment has its own arrangements for ventilating and heating. In the center of each coach is a space about the size of three staterooms, which is well equipped for a lounging room. Meals are served at all hours up to midnight in a well-appointed dining car. In one end of this car, and separated from the dining room by the kitchen, is a bathroom and small gymnasium.

The southern and central sections of this road were opened for business as soon as completed, and the immediate results of both passenger and goods traffic was far greater than had been anticipated. From September, 1895, to 1899, inclusive, these two sections carried 3,352,000 passengers, 2,041,000 tons of freight and 996,000 persons emigrated to Siberia, which makes an average of about 232,000 persons a year. This all-rail connection between the Atlantic and Pacific coasts now offers to Russia advantages, both commercial and strategic, which makes the great cost of the road seem insignificant in comparison.

Through the co-operation of the mechanical and the engineering departments of the New York Central & Hudson River Railroad, Purdue University has received an exhibit of primitive railway track. This track was exposed in the course of certain excavations which have recently been in progress on the line of the old Mohawk & Hudson Railroad. Notwithstanding the fact that it had been so long covered that everybody connected with the road appears to have entirely forgotten its existence, it was found to be in a fair state of preservation. The exhibit consists of stone sleepers, stringers and rails, and altogether weighs 2,700 lbs. This section of primitive track from the State of New York will supplement an exhibit of the so-called "bull-rail" track, representing a somewhat later date, taken from the Central Railway of Georgia, and deposited with Purdue University through the courtesy of Mr. Theo. D. Kline, General Superintendent of that road.

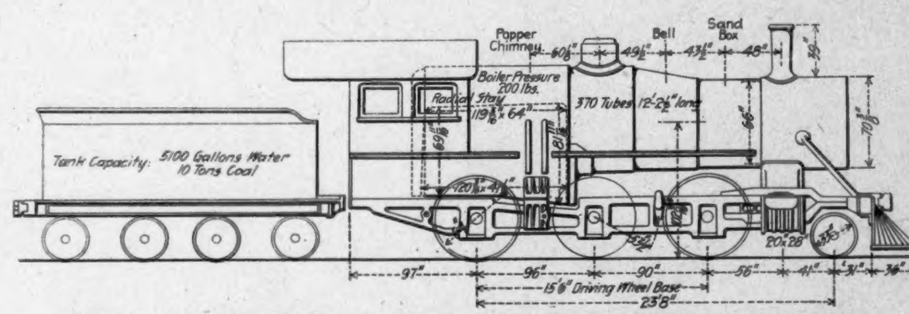


Profile of the Michigan Central—Michigan City to Jackson Junction.



COMPOUND CONSOLIDATION LOCOMOTIVE, CLASS W.—MICHIGAN CENTRAL RAILROAD.

Cylinders.......... 23 and 35 by 32 in. Boiler preseure.............. ....210 lbs.
Wheels : Driving, diameter ......63 in.; engine truck.......33 in. tender..........33 in.
Weights : Total of engine........ ....189,000 lbs.; on drivers........ ....164,500 lbs.
Grate area and tubes: Grate area............50.3 sq. ft. Tubes.....365—2 in., 16 ft. long.
Firebox : Length. .....96⅛ in.; width .....75⅜ in.; depth, front....71 in.; back....61 in.
Boiler : type ....straight, wide firebox; Diameter....................70⅛ in.
Heating surface : Tubes....3,074.24 sq. ft.; water tubes...28.27 sq. ft.; firebox...148.05 sq. ft.; total................ ...3,250.56 sq. ft.
Wheel base : Driving.............17 ft., rigid, 17 ft; total of engine.............25 ft. 4 in.; total, engine and tender ....53 ft. 7⅛ in.
Tender........Eight-wheel; water capacity ....5,100 gals.; coal capacity........10 tons.



MOQUL LOCOMOTIVE, CLASS P.—MICHIGAN CENTRAL RAILROAD.

Cylinders...............................20 by 28 in. Boiler pressure.......................200 lbs.
Wheels: Driving, diameter..... 64 in.; truck wheels......33 in.; tender wheels..... 33 in.
Weights: Total of engine.... .. ..162,500 lbs.; on drivers................. 141,000 lbs.
Grate area and tubes: Grate area... ....34.6 sq. ft. Tubes........370—2 in.—12 ft. 2⅛ in. long.
Firebox: Length.......120 in.; width......41⅛ in.; depth, front..... 81 in.; back......69 in.
Boiler. type radial stayed, firebox between wheels. Boiler diameter .. ..67 in.
Heating surface: Tubes......2,348 sq. ft.; Arch tubes......34.2 sq. ft.; firebox......200.7 sq. ft. total...............2,583.8 sq. ft.
Wheel base: Driving .. 15 ft. 6 in.; total wheel base....23 ft. 8 in.; Tender... Eight-wheel. Water capacity...............5,100 gals.; coal capacity.............. 10 tons.

Comparative Locomotive Tests—Michigan Central.

E. D. BRONNER, *Superintendent Motive Power and Equipment.*

G. E. PARKS, *Mechanical Engineer.*

COMPARATIVE LOCOMOTIVE TESTS.

Michigan Central Railroad.

Involving Compound Cylinders, Wide Firebox and a Heavy Engine.

Through the courtesy of Mr. E. D. Bronner a record of locomotive tests recently made on the Michigan Central Railroad has been received. The tests were undertaken to determine the policy of building heavier engines, and to ascertain the extent of their advantages, combined with wide fireboxes and compounding, and for short time tests are unusually interesting.

The comparison was made between a 20 by 28-in. simple mogul, weighing 162,500 lbs., and a 23 and 35 by 32-in. two-cylinder Schenectady compound consolidation, weighing 190,000 lbs., and it was so distinctly favorable to the compound as to lead to an order for 20 engines of that type, the trials having been conducted with a sample engine built for the purpose. The consolidation engine closely resembles the one by the Schenectady Locomotive Works for the New York Central, illustrated on page 83 of our March number of the current volume. The dimensions of the compound are given in the accompanying table, and the indicator cards on page 380.

In order to secure comparative information with reference to fast and slow freights the tests were made on both engines at speeds of 20 and 25 miles per hour. The record shows that these speeds were very closely followed in the eight test trains. Because of the completeness of the data the record sheet is reproduced in full. Some of the observations, such as the position of the throttle, the number of blasts of the whistle, the number of seconds of blowing off at the pops, the length of time the blower was used, and strokes of the air pump, give rather rough comparisons, but this data is valuable in comparing the conditions, and some of these figures tend to throw light on the operation of the engines and their steaming qualities. In this way a large amount of steam is accounted for in addition to that used in the cylinders. This corresponds to the large drain upon the boilers of a steam vessel for the auxiliaries. It is unusual to find so many of these figures taken in a locomotive test.

The tests were conducted by the motive power department on the West and Air Line divisions between Michigan City and Jackson Junction, a distance of 139 miles, and with east-bound trains because that was the direction of heavy freight movement. The test trains were given the right of way, and the same engineer and fireman handled both engines. With the slow trains the tonnage was made as large as possible and avoid stalling. For the mogul 1,700 tons were asked for and for the consolidation 2,000 tons for the slow trains, and because the trains were not weighed until the end of the run the mogul received less and the consolidation more than was asked for. The trains were weighed on track scales at Jackson Junction. The fast trains were of the same class of freight, but were lighter, in order to make the time. Platform scales were used for weighing the coal, and extra coal was carried in 150-lb. bags. For each run samples of the coal, which was all from the same mine, were taken and tested in a calorimeter in the laboratory of the University of Michigan at Ann Arbor. The observers were under the direction of Mr. George E. Parks, Mechanical Engineer of the road.

Comparing the speeds of the two engines it appears that with the slow trains the mogul averaged 1,646 tons, and made the run in 7 hours 16 minutes with 6½ stops. The consolidation averaged 2,075 tons and 7 hours 15 minutes with 7½ stops. The heavier engine hauled the increased tonnage and made one more stop in the same time. With the fast trains the mogul averaged 1,280 tons and made the run in 5 hours 21 minutes with 5 stops. The consolidation averaged 1,512 tons in 5 hours 35 minutes with the same number of stops. The consolidation hauled 213 more tons and required 14½ minutes more than the mogul. The heavy engine made the schedule time on the Air Line division with 35 minutes to spare for emergencies, and is satisfactory in this respect. With the condition of these tests the following conclusions were drawn:

Conclusions.

Water Consumption.—A gain of 6.9 per cent. may be expected from the compound, as shown by the cylinders, based upon the steam consumption per indicated horse power per hour. This is smaller than would be expected, but it is apparent that the compound was overloaded.

Heat Units.—A gain of 17 per cent. is shown in favor of the compound in equivalent evaporation in terms of a given number of heat units.

Fuel Consumption.—The most important fact brought out by these tests is the gain by the compound of 22 per cent. in fuel consumption when compared on the basis of the number of heat units required to haul one ton of freight one mile.

These tests were made under specially well-selected conditions, and while they show the marked advantage of the compound it is impossible to separate this into the portions which are due to the larger boiler, larger grates and compound cylinders. It is to be regretted that the wages and items of cost could not be added to these engineering comparisons. These tests establish the compound as the better engine including all of these features, but it cannot be said that this is because of the compound feature alone. The data were taken in a thorough way, and with a fair comparison as to speeds. The cylinder and boiler performances are remarkably good, as indicated in lines 58, 62 and 64 of the table. Of course the cylinder performance affects the boiler, because good work in the cylinders causes a reduced drain upon the boiler. The wide firebox appears to good advantage in line 52, which is also due in part to the compounding. This is an important comparison, which probably has a great deal to do with the relative standing of the engines. In line 65 the water per I. H. P. per hour for the cylinders alone is remarkably low for the compound, averaging 22.56 lbs. Line 23 shows that the mogul did not steam as freely as the consolidation, and line 25 indicates that the consolidation steamed freely and that the fireman was, probably, not accustomed to the wide grate. The draft in the smokebox was less in the compound, as seen in line 38, and it was also much less in the ashpan of that engine. Line 46 shows that the consolidation was loaded much nearer to its limit than the lighter engine. Line 73 expresses the economy of the compound in terms of heat units, and this item alone might be made the subject of interesting studies in the selection of coal, as well as in locomotive design.

These tests are heartily commended, but it should be understood that these comparisons do not include the most important figures of all, the total cost in terms of a given tonnage hauled one mile. If these figures were included the true record of the heavier engine would stand out in a way which would appeal to the manager still more forcibly than the results which are given in mechanical engineering terms. The saving in train crew wages would unquestionably amount to more than that expressed in this admirable report.

COMPOUND CONSOLIDATION LOCOMOTIVE.

Michigan Central Railroad.

General Dimensions.

Gauge	4 ft. 8½ in.
Fuel	Bituminous coal
Weight in working order	189,000 lbs.
Weight on drivers	164,500 lbs.
Wheel base, driving	17 ft.
Wheel base, rigid	17 ft.
Wheel base, total	25 ft. 9 in.

Cylinders.

Diameter of cylinders	23 and 35 in.
Stroke of piston	32 in.
Horizontal thickness of piston	H.P., 4¾ in.; L.P., 4⅛ in.
Diameter of piston rod	4 in.
Kind of piston packing	Plain rings
Kind of rod packing	U. S.
Size of steam ports	L.P., 23 in. x 2⅛ in.
Size of exhaust ports	L.P., 23 in. x 3 in.
Size of bridges	L.P., 1⅜ in.

Valves.

Kind of slide valves........H.P., piston type; L.P., Allen-Richardson
Greatest travel of slide valves..6 in.
Outside lap of slide valves...................H.P., 1¼ in.; L.P., 1 in.
Inside clearance of slide valves................H.P., ⅛ in.; L.P., ¼ in.
Lead of valves in full gear.................................1/32 in. blind
Kind of valve stem packing..U. S.

Wheels, Etc.

Diameter of driving wheels outside of tire............................63 in.
Material of driving wheel centers..................................Cast steel
Driving box material...Cast steel
Diam. and length of main crank pin journals,
Main, 9½ in. x 12 in.; others, 9 in. in dia. x 12 in.
Diam. and length of main crank pink journals,
Main side, 7½ in. x 5¼ in.; 6 in. dia. x 6 in.
Diam. and length of side rod,
Inter., 5½ in. x 4¾ in.; F. & B., 5 in. dia. x 3¼ in.
Engine truck journals..................................6 in. dia. x 12 in.
Diameter of engine truck wheels..33 in.

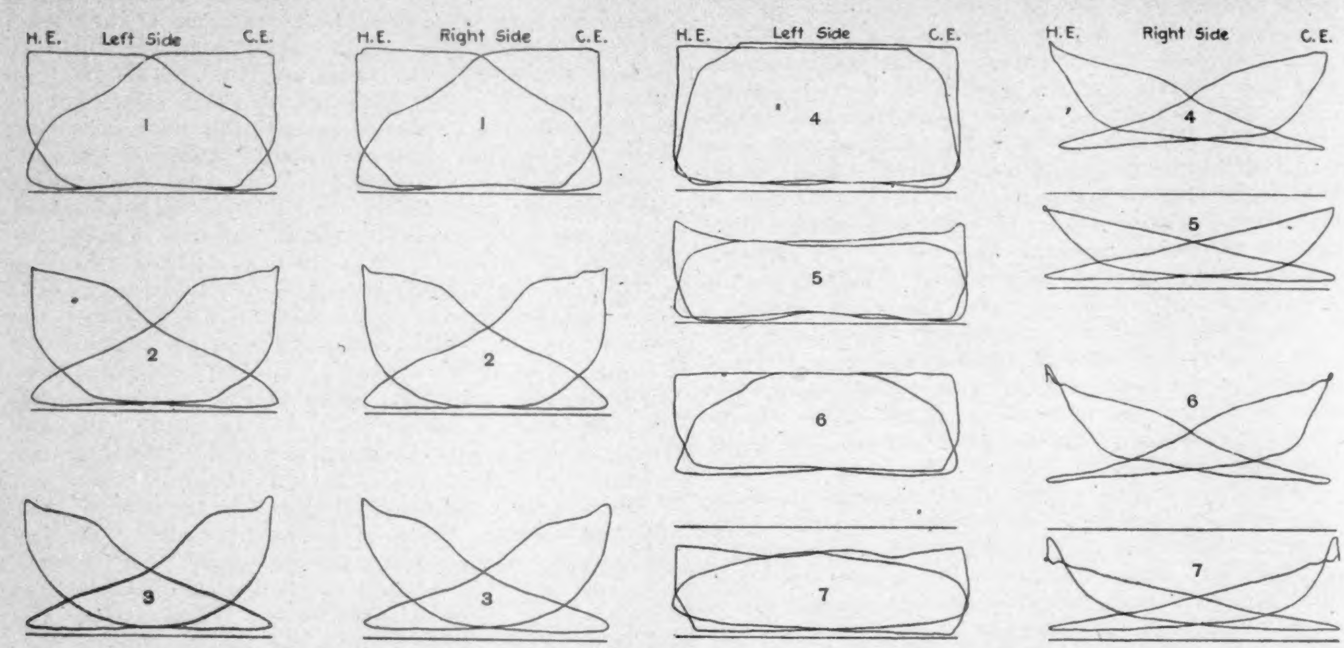
Boiler.

Style...Straight, with wide firebox
Outside diameter of first ring.......................................70⅝ in.

Heating surface, water tubes..28.27 sq. ft.
Heating surface, firebox..148.05 sq. ft.
Heating surface, total...3,250.56 sq. ft.
Grate surface ....50.31 sq. ft.
Grate, style..Rocking, in 4 sections
Ash pan..............Hopper, with slides and lining M. C. standard
Exhaust pipes ....Single
Exhaust nozzles...........................5 in., 5¼ in., 5½ in. dia.
Smokestack, inside diameter..14 in.
Smokestack, top above rail..14 ft. 8 in.
Boiler supplied by....2 Hancock inspirators, Type A, No. 10, R. & L.

Tender.

Weight, empty...44,700 lbs.
Wheels, number of..8
Wheels, diameter...33 in.
Journals, diameter and length...............................5 in. dia. x 9 in.
Wheel base ....16 ft. 5½ in.
Tender frame ....10-in. steel channels
Tender trucks ....Fox pressed steel
Water capacity...5,100 U. S. gallons
Coal ....10 tons
Total wheel base of engine and tender.............................53 ft. 7¼ in.



Cards Taken From Simple and Compound Locomotive–Michigan Central Railway.

Locomotive.	Number 288.				Number 590.				
						Working simple.	Working compound.		
No. of card		1*	2	3		4	5	6	7
Date		August 10, 1901.				Sept. 1, 1901	Sept. 3, 1901.	Sept. 3, 1901.	Sept. 3, 1901.
Grade, feet per mile		32	7	11		40	40	0	28
Train load, tons		1276	1276	1276		2160	1992	1992	1992
Speed, miles per hour		11.5	21.5	28		4	13	27	33⅛
Revolutions per minute		61	113	147		21.3	69	144	179
Steam pressure, lbs		200	200	190		205	210	205	210
Scale of spring, lbs. per inch		120	120	120	H. P.	120	120	120	120
					L. P.	80	80	80	80
Cylinder data—									
Head end	R. S. M. E. P.	147.5	102.4	76.9	H. P. M. E. P.	171.8	115.5	45.2	35.8
	R. S. I. H. P.	197.1	255.7	250	H. P. I. H. P.	121.3	265.2	215.7	211.7
Crank end	R. S. M. E. P.	145.4	100.6	78.1	H. P. M. E. P.	172.2	115.1	49.3	40.2
	R. S. I. H. P.	191.9	248.4	251.2	H. P. I. H. P.	119.7	260.1	231.5	234.3
Both ends	R. S. I. H. P.	389.0	504.1	501.2	H. P. I. H. P.	241.0	525.3	447.2	446.0
Head end	L. S. M. E. P.	145.0	99.5	74.5	L. P. M. E. P.	64.6	60.4	23.6	17.1
	L. S. I. H. P.	192.6	246.9	240.7	L. P. I. H. P.	106.5	323.9	262.9	236.4
Crank end	L. S. M. E. P	146.3	100.4	74.9	L. P. M. E. P.	66.1	61.1	24.1	17.6
	L. S. I. H. P.	191.9	246.1	239.2	L. P. I. H. P.	108.2	325.4	266.4	241.3
Both ends	L. S. I. H. P.	384.5	493.0	79.9	L. P. I. H. P.	211.7	649.3	529.3	477.7
Total I. H. P.		773.5	997.1	981.1		455.7	1174.6	976.5	923.7
Per cent. H. P. developed in L. P. cylinder		....	....	....		47.1	55.2	54.2	51.7

*Starting with helper.

Working pressure...210 lbs.
Thickness of plates in barrel and outside of firebox..⅜, ½, 13/16 in.
Firebox, length ....96⅛ in.
Firebox, width ....75⅝ in.
Firebox, depth ....F., 71 in.; B., 61 in.
Firebox, material ....Carbon steel
Firebox plates, thickness,
Sides, 5/16 in.; back, ⅜ in.; crown, ⅜ in.; tube sheet, ½ in.
Firebox water space,
Front, 4 and 5 ins.; sides, 3½ ins. and 5½ ins.; back, 3½ and 4½ ins.
Firebox crown staying...................................Radial, 1⅛ in. diam.
Firebox staybolts..1 in. diam.
Tubes, material...Charcoal iron, No. 12
Tubes, number of..369
Tubes, diameter..2 in.
Tubes, length over tube sheets...16 ft.
Fire brick, supported on..Water tubes
Heating surface, tubes.....................................3,074.24 sq. ft.

The effect upon the track of the present practice of using flanges on all of the driving wheels of locomotives was the subject of a paper by Mr. Hugh Wilson, of the "Burlington," read before the Rocky Mountain Railway Club recently. Mr. Wilson analyzed the relations between the flanges and the rails on various curves, and showed that there is in all usual cases sufficient play to relieve the rails from increased stresses. The track was really favored by the practice of abandoning blind tires. The only case in which danger occurred was when frogs were placed in the inside rail of a curve which is above about 9 degrees.

Comparative Locomotive Tests—Michigan Central Railroad.

SHOWING THE COMBINED ADVANTAGES OF COMPOUNDING, WIDE GRATES AND LARGE LOCOMOTIVES.

Type of engine	Mogul, simple	Consolidation, compound
Size of cylinders, inches	20 by 28	23 and 35 by 32
Type of boiler	Wagon top	Straight
Kind of firebox	Narrow	Wide
Area of heating surface	2,583.9	3,217.1
Area of grate surface	34.6	50.3
Kind of exhaust nozzle	Single	Single
Diameter of exhaust nozzle, inches	5	5¼
Average weight (tons) of engine and tender, including coal and water	126	140

1. Date	Aug. 1	Aug. 3	Aug. 8	Aug. 10	Sept. 1	Sept. 3	Sept. 5	Sept. 7
2. Kind of coal used	Fairm'nt	Fairm'nt	Fairm'nt	Fairm'nt	Fairm'nt	Fairm'nt	Fairm'nt	Fairm'nt
3. Kind of train	Slow	Slow	Fast	Fast	Slow	Slow	Fast	Fast
4. Length of route in miles	140	140	140	140	140	140	140	140
5. Number of empty cars	6	8	7	6	10	4	2	6
6. Number of loaded cars	46	55	39	41	56	52	49	41
7. Total number of cars	52	63	46	47	66	56	51	47
8. Weight of cars in tons	1,654.45	1,638.97	1,286.01	1,275.85	2,159.62	1,991.58	1,528.68	1,495.80
9. Number of ton-miles of train load	231,623	229,455.8	180,041.4	178,619	302,247.8	278,821	214,016.2	209,425.8
10. Number of ton-miles of total load	249,263	247,095.8	197,681.4	196,259	321,947.5	298,421	233,616.2	229,025.9
11. Total number of stops made	4	9	7	3	7	8	5	5
12. Total time on the road with train, in hours and minutes	7 59½	9 10	6 52¾	5 20¾	9 26⅝	9 19⅛	6 31⅜	6 52
13. Total time actual running, in hours and minutes	7 02	7 30	5 18½	5 23¾	7 39⅝	6 51⅓	5 42⅓	5 28¼
14. Total time throttle was open, in hours and minutes	6 35½	6 39¾	4 43	4 50¼	6 53¼	6 03	5 02	4 47
15. Total weight of coal consumed, pounds	17,398	18,979	14,759	15,848	20,192	17,191	15,095	14,622
16. Per cent. of ash as found by coal calorimeter test	6.37	7.24	5.98	7.26	10.20	8.44	7.91	8.57
17. Total heat of combustion as found by calorimeter test	14,756	13,934	14,354	13,283	13,157	13,880	13,208	13,419
18. Total weight of water evaporated, corrected for moisture of steam and loss at injector	131,097	141,915	112,874	113,114	160,362	145,525	126,133	121,664
19. Total weight of steam used by engine cylinders, corrected for moisture, losses at calorimeter air pump, whistle, etc.	122,166	130,239	105,317	103,604	148,706	133,099	116,561	110,694
20. Total number of strokes of the air pump	19.736	28,987	17,035	23,980	30,265	28,920	22,500	24,750
21. Total number of long whistle blasts	290	284	278	276	231	241	269	263
22. Total number of short whistle blasts	272	262	248	263	214	246	259	258
23. Total number of minutes blower was in operation	32	44	30	25	24	4	6	10
24. Total number of times the injector was started	27	31	20	15	21	17	14	17
25. Total number of seconds pops were blowing	420	228	264	138	67	664	374	626
26. Total equivalent weight of water evaporated from and at 212 degs. F., corrected for moisture in steam, etc	156,831	170,028	135,325	135,827	193,012	175,125	151,839	146,532
27. Mean effective pressure, right side or L. P. cylinder, head end	88.24	94.25	75.75	73.88	37.99	35.31	27.16	26.39
28. Mean effective pressure, right side or L. P. cylinder, crank end	87.26	93.48	76.57	75.51	37.81	35.52	27.55	27.09
29. Mean effective pressure, left side or H. P. cylinder, head end	89.90	92.53	73.88	72.91	73.55	68.70	55.04	52.28
30. Mean effective pressure, left side or H. P. cylinder, crank end	90.28	93.43	75.82	74.67	73.25	68.59	56.72	54.57
31. Average number of revolutions per minute	115.23	108.03	148.59	143.48	101.33	113.98	137.83	145.30
32. Indicated H.-P., right side or L. P. cylinder, head end	202.25	201.29	231.70	216.27	254.39	275.93	265.50	263.63
33. Indicated H.-P., right side or L. P. cylinder, crank end	198.26	197.15	230.59	219.86	250.86	277.78	269.15	269.06
34. Indicated H.-P., left side or H. P. cylinder, head end	205.33	195.01	223.71	212.26	219.41	235.27	235.16	231.49
35. Indicated H.-P., left side or H. P. cylinder, crank end	203.86	195.18	227.43	215.95	215.70	233.00	240.80	247.47
36. Indicated horse-power whole engine	809.70	788.63	913.43	864.34	940.36	1,021.98	1,010.61	1,011.65
37. Average boiler pressure	193.1	191.1	196.7	196.1	202	209.5	203.8	208.2
38. Average draft of smokebox, in inches	5.6	5.4	5.1	4.5	4.4	4.2	4.1	4.5
39. Average draft in ash-pan, in inches	1.1	1.3	1.4	1.4	.58	.63	.47	.60
40. Average temperature of feed water, in degs	76	74	74	72	70	71	70	70
41. Average per cent. of moisture in steam in per cent	2.92	3.3	2.26	2.08	1.81	1.99	1.95	2.04
42. Average position of throttle (1 = wide open)	.74	.80	.81	.76	.93	.95	.89	.96
43. Average position of reverse lever in inches	9.79	10.63	8.83	8.38	18.14	17.53	16.63	16.36
44. Average speed in miles per hour	19.90	18.66	26.37	25.93	18.38	20.38	24.52	25.59
45. Maximum speed in miles per hour	38	38	42	42	35	37	37	40
46. Minimum speed at top of Buchanan Hill	8	10	17	15	2½	8	15	16
47. Maximum speed at foot of Buchanan Hill	29	32	39	37	31	33	35	37
48. Minimum speed at top of Grub Hill	7	3	18	16	1	10	12	16
49. Maximum speed at foot of Grub Hill	34	26	35	33	24	30	31	32
50. Average number of strokes of air pump per minute	41.1	52.7	41.2	62.9	53.4	51.7	57.4	60
51. Pounds of coal burned per hour	2,639.6	2,863	3,129.5	3,276.4	2,931.6	2,841.4	2,999	3,056.8
52. Pounds of coal burned per square foot of grate per hour	76.28	82.74	90.44	94.7	58.3	56.5	57.6	60.7
53. Pounds of coal burned per sq. ft. of heating surf. per hr.	1.021	1.108	1.211	1.268	.911	.883	.932	.95
54. Pounds of water evaporated per hour	19,890	21,408	23,934	23,385	23,283	24,053	25,059	25,435
55. Lbs. of water evaporated per sq. ft. of heat'g surf. per hr.	7.69	8.28	9.26	9.05	7.23	7.47	7.78	7.90
56. Equivalent weight of water evaporated per hour from and at 212 degs. F.	23,794	25,649	28,694	28,080	28,023	28,946	30,166	30,634
57. Equivalent weight of water evaporated per hour from and at 212 degs. F. per sq. ft. of heating surface	9.20	9.92	11.10	10.86	8.71	8.99	9.37	9.52
58. Pounds of coal consumed per I. H. P. per hour	3.260	3.633	3.426	3.790	3.117	2.780	2.967	3.021
59. Pounds of coal consumed per ton-mile of train load	.0751	.0827	.0819	.0887	.0667	.0616	.0705	.0698
60. Pounds of coal consumed per ton-mile of total load	.0692	.0768	.0747	.0807	.0627	.0576	.0646	.0638
61. Water evaporated per pound of coal	7.53	7.47	7.64	7.13	7.94	8.46	8.35	8.32
62. Equivalent evaporation per pound of coal from and at 212 degs. F.	9.01	8.96	9.17	8.57	9.55	10.18	10.06	10.02
63. Heat imparted to each pound of steam used from average temperature of feed at average steam pressure, in British thermal units	1,155.27	1,156.97	1,157.73	1,159.65	1,162.36	1,162.11	1,162.54	1,163.08
64. Total water consumed per indicated horse-power per hour, corrected from moisture in steam	24.56	27.14	26.22	27.05	24.76	23.53	24.79	25.14
65. Water consumed per I. H. P. per hour by cylinders alone.	22.89	24.91	24.44	24.78	22.96	21.52	22.91	22.87
66. Weather and condition of rail	Good	Good	Good	Good	Good	Good	Good	Good

67. Average number of heat units per pound of coal used	14,082	13,415
68. Average equivalent number of pounds of water evaporated from and at 212 degs. F. for each 1,000 heat units in the coal	.6337	.7418
69. Average number of pounds of steam used per horse-power per hour, cylinders only	24.255	22.565
70. Average number of heat units used to haul one ton of freight one mile	1,156.13	900.82
71. Per cent. gain of compound over the simple as shown in the boiler, based upon equivalent evaporation per 1,000 heat units	......	17.0
72. Per cent. gain of compound over the simple as shown in the cylinders, based upon steam consumption per horse-power per hour	......	6.9
73. Per cent. of gain of compound over the simple as shown in heat units required to haul one ton of freight one mile	......	22.0

36-FOOT, 40-TON BOX CARS WITH END PLATFORMS.

Chesapeake & Ohio Railway.

Through the kindness of Mr. W. S. Morris, Superintendent of Motive Power, drawings for 40-ton box cars having end platforms, built for the Chesapeake & Ohio Railway, have been received. These cars are built to the originally recommended standard dimensions of the American Railway Association, viz.:

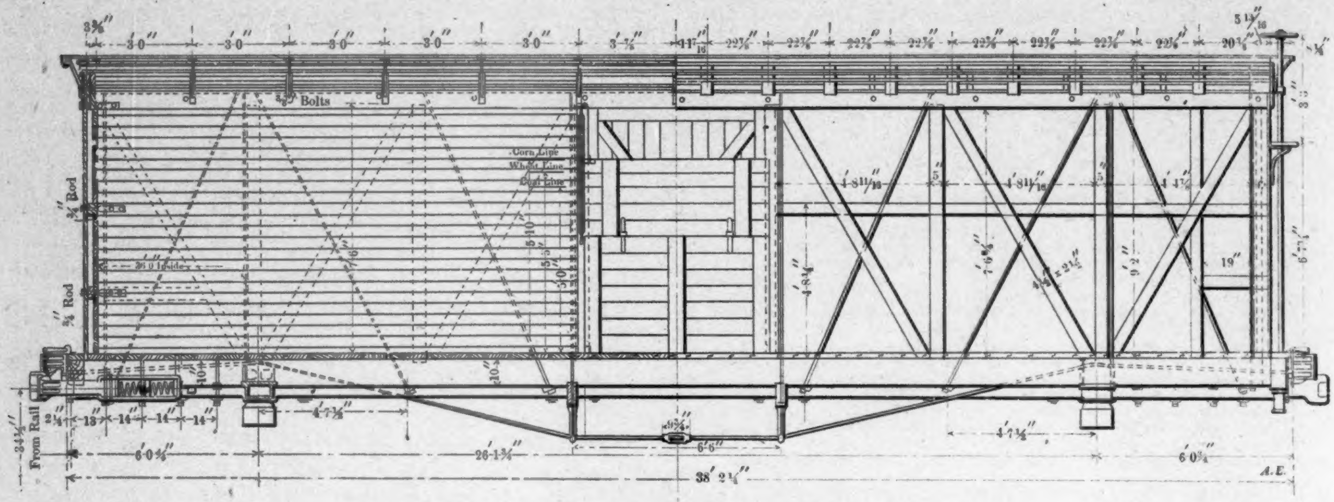
Length	36 ft. 0 in.
Width	8 ft. 6 in.
Height	7 ft. 6 in.

A car 36 ft. long, 8 ft. 6 ins. wide, and 8 ft. high (all inside dimensions), was originally favored by the association, but because it was subsequently stated that cars 8 ft. high (inside) could not be transported over certain lines, the height was recommended to be 7 ft. 6 ins. On April 24, 1901, the association found that the objection to the higher car had been removed, and at the St. Louis meeting, in October, as recorded elsewhere in this issue, the height of 8 ft. was adopted. These cars, therefore, do not conform to the adopted standard. The general dimensions of the cars are given in the following table:

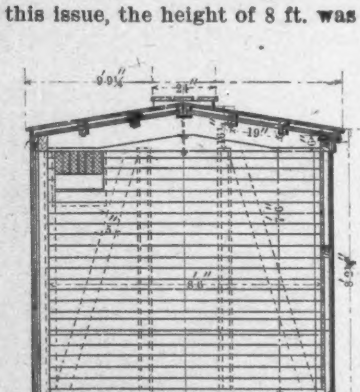
General Dimensions.

Length of framing over end sills	38 ft. 3¼ in.
Length over siding	36 ft. 10¼ in.
Length inside	36 ft. 0 in.
Length over running boards	38 ft. 2⅜ in.
Width over side sills	9 ft. ⅜ in.
Width over siding	9 ft. 2½ in.
Width inside	8 ft. 6 in.
Width of door opening	5 ft. 6 in.
Height between sill and plate	7 ft. 6⅜ in.
Height from floor to under side of carlines	7 ft. 6 in.
Height from rail to top running board	12 ft. 11⅜ in.
Height from rail to top brake shaft	13 ft. 10¼ in.
Height from rail to eaves	12 ft. 0 in.
Height from rail to center of coupler	2 ft. 10½ in.
Center to center of trucks	26 ft. 1¾ in.
Center to center of tie timbers	6 ft. 6 in.

At the ends of the cars 8 by 11-in. oak end sills are placed outside of the car, and the truss rods, of which there are six, pass through them. These timbers are supplied with end-sill cover boards and form a narrow platform at each end of the car. The cars have metal bolsters and Chicago grain doors. The draft timbers are secured to the under faces of the center sills and are continuous. The draft gear is the Miner tandem arrangement with malleable draft arms. In general, the cars follow the customary practice of Mr. Morris and the drawings show this clearly. The body of the car is low, and is mounted on standard 40-ton trucks with cast-steel truck bolsters. Three hundred of these cars have recently been put into service. Mr. Morris stated that this design was made before the adoption of the standard, and that future construction will be made to the standard inside dimensions.



36-Foot, 40-Ton Box Car—Chesapeake & Ohio Railway.
W. S. Morris, Superintendent Motive Power.



Transverse Section.

A CROOKED RAILROAD.

The Baltimore & Ohio Railroad Company is building four miles of line in Pennsylvania, which is believed to be the crookedest railroad in the United States. This little road will extend from Boswell, Pa., to Friedens on the Somerset & Cambria branch of the Baltimore & Ohio. The air-line distance is about five miles, but the peculiar conformation of the country makes it necessary to loop a number of hills in order to get an easy grade. The new road doubles on itself four times, and at one point, after making a loop of about five miles, the road comes back to within 300 ft. of itself on a grade 50 ft. lower.

A very good run was made November 9 by the Philadelphia & Reading from Camden to Atlantic City. This special train left Camden about 1:30 P. M. with a party composed of Mr. Theodore Voorhees, First Vice-President of the road; Mr. Gibb, General Manager; Mr. Harrison, Chief Engineer; Mr. Burtt, General Traffic Manager, and Mr. Newell, Docks Engineer, all of the North Eastern Railway (England). Other officials of the Reading and their friends were aboard the train. The train was made up of five cars, which weighed 235 tons behind the tender, and was hauled by the Vauclain compound Atlantic type engine No. 326. The engine has 84-in. drivers and 2,550 sq. ft. of heating surface. The run of 55½ miles was made from start to stop in 46½ minutes, or at the rate of 71.6 miles an hour. There were no stops, but speed was checked three times. During the run 35 miles was covered at 81½ miles an hour, and the fastest single mile was made at 85.7 miles an hour. The last two miles were run to an absolute stand in 120½ seconds.

POWER STATION OF THE NEW YORK RAPID TRANSIT RAILWAY.

The power to be used in operating the lines of the Rapid Transit Subway in New York City is electricity, which will be transmitted by means of the third rail system. The equipment for the power house, according to present specifications, will consist of eight entirely independent units, of which the engines and boilers have been contracted for. Each of the eight engines, to be built by the Allis-Chalmers Company, of Chicago, will have direct pipe connections to six Babcock & Wilcox boilers, provided with wrought-steel headers. These engines are of the same general type as used in the power house of the Manhattan Railway Company of New York, and described in our issue of May, 1901, page 140. They will be run at 75 revolutions per minute, and at their best efficiency will develop 75,000 h.p. The cylinders are 42 and 86 ins. in diameter, with a stroke of 60 ins., and are jacketed by steam, which passes direct from the throttle to the jackets before entering the admission valves. A pair of cylinders arranged on the compound principle are attached to each end of the main shaft by a crank, the high pressure cylinders being located in a horizontal position, while the low-pressure cylinders are vertical. In order to use superheated steam at a temperature of 500 to 550 degs. Fahr., the high-pressure cylinders are provided with poppet valves. The steam pressure to be used is from 175 to 200 lbs. The boilers are rated at 600 horse-power, and each has a heating surface of 6,200 sq. ft. They will be located on one floor of the power house, with four chimneys built upon steel structures, so as to give access to the full floor space. The boilers will be equipped with mechanical stokers, and the plant supplied with efficient coal and ash-handling machinery.

A NEW SERPOLLET BOILER.

A company is being formed for the manufacture and introduction of a new steam generator, which was described in a recent consular report.

This powerful generator, constructed by M. Serpollet, is made of cast steel, fused at 1,800 degrees C. Within, it is an arrangement of non-capillary tubes, and it is in these that the instantaneous vaporization is effected without danger of escape, up to a pressure of 80 kilograms (176 lbs.). The apparatus placed in the firebox constitutes a sort of blower, allowing great facility to the fire draft. On account of its heavy construction it offers ample resistance to the pressure. It is claimed that it is not affected by immediate contact with the fire, and that capillary action is completely suppressed. By this apparatus an absolutely new departure is brought about in the generating of steam, and it is contended that its application will be of incalculable value either as a motor agent or in the employment of steam dried at hitherto unknown temperatures. Either coal, coke or petroleum may be used for fuel.

INTERNATIONAL RAILWAY CONGRESS

Meets in the United States in 1905.

Last month it was announced that at the invitation of the American Railway Association the International Railway Congress would hold its next convention in the United States. May, 1905, has been fixed as the time, and probably Washington, D. C., will be the place.

To provide an organization to manage the preparations, the American Railway Association will appoint 25 members of an "American Section," of which the executive board of the association will form the nucleus. This body will have complete charge of the convention.

This meeting will be an important one because of the opportunity it will offer foreigners to study American railroad practice, and because it will bring to this country the leading operating, engineering and motive-power men of Europe.

COMPRESSED AIR AS A SAFE POWER.

Considerable attention has been called recently to compressed air explosions, so much in fact, that an impression might be given that compressed air is an unsafe power. On the contrary, it is the safest power or means of transmitting power that is in use at the present time. When we consider the great number and variety of uses to which compressed air has been applied in its comparatively short period of development, it is to be expected that some failures would occur, but it is only through ignorance of the cause of these explosions and carelessness on the part of engineers that these troubles do exist.

Compressed air installations are used with pressures up to 3,000 lbs. to the square inch, not only in every mine of any magnitude, in all tunnel work, quarries, ship-building, submarine work and for refrigerating purposes, but it has a very wide range of usefulness in all railroad and manufacturing lines. Nearly every railroad, machine, erecting, boiler shop and foundry of any size has its own compressor plant, and from all of these varied sources comparatively few accidents have been reported. As a means of safety many of the powder magazines throughout the country are using compressed air as a motive power, to the exclusion of steam and electricity. Railroad trains, both freight and passenger, are equipped with air compressors and storage tanks, and on the latter the power is used for as many as eight different purposes, such as the braking of trains, ringing bells, opening fire doors, shaking grates, sanding the rails, lifting tender water scoops, raising water in passenger coaches and operating fans for ventilation.

The reason why compressed air is a safe power is the fact that it has no reserve force, as in the case of steam boiler explosions, where the destructive effect is caused chiefly from this force, that is, the sudden conversion of large volumes of superheated water into steam, by the reduction of pressure above the water space in the boiler. In the case of air, when a vent occurs, it serves to reduce the strains. This is due not only to the expansion of the air from a smaller space into a larger one, but a rapid reduction in volume, due to the fall of temperature in expanding. The failures that have occurred in the use of compressed air can, in nearly every instance, be traced back to the ignition of oil or some inflammable substance which is used with the air. Low-test lubricating oil, for example, fed to the air cylinders, may meet with a temperature greater than that of its flashing point. In putting oil into the cylinders, any surplus that may reach the cylinders is forced out through the delivery valves into the air pipes and receivers. The products of decomposition of a large quantity of oil in the receiver would, with the air, form an explosive mixture.

Air in itself is a perfectly safe fluid, and only requires a vessel strong enough to hold it. In this respect the problem is not a serious one, as the factor of safety in the case of air may be less than for steam, water or gas, as it does not corrode the vessel, its temperature is not changed, and it causes no internal destruction.

It will thus be seen that air is the cleanest, healthiest and, except through the course of compression, is as nearly absolutely safe as any power of this kind can be.

Wireless telegraphy is likely to have a rapid development under a contract just closed by Lloyd's Agency to use the Marconi system exclusively for fourteen years for reports between vessels and their signal stations on the coasts of Great Britain and the United States.

Acetylene gas is being used to some extent on the Santa Fe System and the Chicago, Burlington & Quincy Railroad for lighting cars, and in a number of instances for locomotive headlights. Each car has its own generating plant, placed in a small cabinet 30 by 18 ins. in size. In starting, a maximum pressure of 1½ lbs. is attained, and the operating pressure is ¼ of a pound.

(Established 1832.)

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EDITORIAL ANNOUNCEMENTS.

Advertisements.—*Nothing will be inserted in this journal for pay,* EXCEPT IN THE ADVERTISING PAGES. *The reading pages will contain only such matter as we consider of interest to our readers.*

Contributions.—*Articles relating to railway rolling stock construction and management and kindred topics, by those who are practically acquainted with these subjects, are specially desired. Also early notices of official changes, and additions of new equipment for the road or the shop, by purchase or construction.*

To Subscribers.—*The* AMERICAN ENGINEER AND RAILROAD JOURNAL *is mailed regularly to every subscriber each month. Any subscriber who fails to receive his paper ought at once to notify the postmaster at the office of delivery, and in case the paper is not then obtained this office should be notified, so that the missing paper may be supplied.* **When a subscriber changes his address** *he ought to notify this office at once, so that the paper may be sent to the proper destination.*

AMERICAN ENGINEER TESTS.

Locomotive Draft Appliances.

Progress of the Work.

In order to conduct this investigation along practical lines a large amount of special apparatus is required. The first to be used is a number of draft gauges and measuring tubes for an examination and measurement of the smokebox with reference to vacuum. When this investigation is completed that of the stacks and nozzles will begin. Under the direction of Professor Goss, Professor William Forsyth has designed a series of special exhaust nozzles, seven in number, and these have been made in the shops of one of the trunk line railroads. At another railroad shop the experimental stacks are being made. Of these there will be four heights, four diameters and two shapes, straight and taper. The stacks and nozzles are designed with a view of making rapid changes in running the tests. This becomes important, considering the fact that with three rates of power the number of different conditions to be studied will be 672.

It would be impossible to conduct these tests with coal as a fuel, and of necessity oil must be used. A standard locomotive fuel-oil burner has been donated by the Atchison, Topeka & Santa Fe Railway, a steam pump to be used in connection with the burner has been furnished by the Snow Steam Pump Works, and the Standard Oil Company has supplied fuel oil sufficient for the entire series. Preparations for receiving and storing the oil at the laboratory are nearing completion. These donations, and the assistance given by the railroads in making the stacks and nozzles, indicate the quality of the appreciation and endorsement the tests receive from the railroads and others. We wish to express our thanks for this substantial interest.

The attention of those for whom these tests are undertaken is directed to the fact that of the large number of extra copies printed less than 400 copies of the October and November issues of this journal remain. These contain the first two installments of the record of the investigation. A surprising amount of interest has been shown in this work. It has led to a large correspondence from authorities on the subject, including Herr Von Borries, of Hannover, Germany, who was intimately associated with the "Hannover Tests." Undoubtedly the demand for the present record will be as great as that of the German tests, $12 having been offered for the 1896 volume of the American Engineer containing the translated report of the work of Von Borries and Troske. The 400 copies of the present record will be supplied to those who order them first. This is fair warning to those who demand back numbers when it is too late to furnish them.

The Master Car Builders' Association will soon prepare to attack the largest and most far-reaching problem it has ever attempted—the design of the standard box car. It is not now a question of possibility or desirability, but one of necessity, for the American Railway Association has opened the way and has given the equivalent of a positive order that the constructive features of the standard car shall be decided by the M. C. B. Association. With its own reputation at stake, the result will unquestionably be worthy of the standing and traditions of the association. Those who are best able to judge believe that "per diem" charges for car service are coming soon, and after the standard car the pooling of freight equipment is not an unreasonable hope.

While the first reason for the action of the American Railway Association was the abolition of the large car, the development of standard construction as well as standard size was a prominent object. With standard interior and exterior dimensions it follows logically that all parts which may properly be standardized should be decided upon, so that the expensive delays which present conditions involve in repairs may be avoided. There is no reason why all the timbers of wooden cars should not in future be made alike, and also the castings; in fact, all parts except those in which the element of progress must be provided for. Roofs, door attachments, trucks, draft gear, air brakes and brake beams may be left for individual selection, and even these may profitably be treated in a new way. The association may perhaps approve of certain construction of parts not standardized, and these may be used to facilitate the movement of cars and the settlement be arranged upon a definite plan. It seems to be assured that the prompt movement of cars will be the most important factor of future developments of car interchange rules.

Whatever the ultimate development of the standard car is to be, this appears to be a movement of transcendent importance. It offers an occasion to which the Master Car Builders' Association will surely rise, and one in which relatively small differences of opinion will give way for the common good.

New locomotives which are now going into service are sure to have a useful life of at least twenty or twenty-five years. Never in the history of the locomotive has any time equaled

the present with regard to rapid and radical advancements in transportation methods. With these facts in mind each new design merits the greatest study and the best possible provision for the future. A few years hence the locomotives of to-day are to be regarded as monuments of efficient engineering or the reverse. Those who appreciate this will soon stand out prominently as men who understand these problems.

On page 297 of this issue is printed a diagram with blank spaces for dimensions of the draft appliances of locomotives. We ask our readers to fill in these blanks in accordance with their practice in locomotives, for both freight and passenger service, having boilers of 64 ins. in diameter and upward. This information is sought in order to ascertain whether the experimental stacks and nozzles designed for the tests by Professors Goss and Forsyth meet all of the conditions of present practice. No apology is made for this request, because the result of the information will be most valuable to the railroads.

The present car famine is unquestionably the most serious which American railroads have ever experienced, and in spite of the fact that phenomenally large orders have been placed for new cars and the railroads are doing all they can to meet the situation, it appears to be growing worse. Not only is it impossible to supply cars, but in important centers there is difficulty in securing means to remove freight from the premises of the railroads. The car side of the question points to the imperative need of radical improvements in car service methods and this constitutes a strong argument of the "per diem" principle, which would undoubtedly serve to greatly increase the available number of cars. This alone would not meet the present need, but it would be more permanently effective than the emergency methods which are adopted after the pressure for equipment has risen. Thoughtful consideration of the situation shows the necessity for revision of the fundamentals in the factors concerned, with a view of the permanent effects of the remedies applied. Perhaps the next crisis of this kind will find the standard car, the "per diem" plan and the pooling of car equipment in use.

In this issue is printed an illustrated description of the most remarkable passenger locomotives which have yet appeared. They are of the prairie type, with large drivers, long tubes, wide fireboxes and compound cylinders, constituting a combination which will unquestionably secure large power and the ability to sustain it continuously. In weight, size and ultimate capacity these engines surpass everything which has appeared up to date, and yet there is nothing among the essentials of the design which can now be considered doubtful or questionable. A six-coupled engine, with 135,000 lbs. on driving wheels, which may be increased to 160,000 lbs. by the use of the traction increaser, and with cylinder capacity to correspond, is certainly a remarkable achievement. The theory of the traction increaser is well received, and its use on such a bold scale as this is worthy of general attention. The devices work out in a very simple and satisfactory way on an Atlantic type engine, but they must be much more complicated for the prairie type. There seems to be no reason to fear improper use of the device by the enginemen, for the experience which is now being had tends to indicate a dislike on the part of the enginemen to use it. Its application to such large locomotives for mountain service seems to be an ideal one, which is very likely to settle the status of this principle in a short time. No better illustration of the tendency toward the building of larger locomotives can be offered than this, and the influence of this design, which so closely follows the first large prairie type engine on the Lake Shore, seems likely to be strong and far-reaching. Having ordered 45 of these engines it may be said that the builders and the "Santa Fe" officers have confidence in their success.

CORRESPONDENCE.

SUGGESTED INCREASE OF DUES IN THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

To the Editor:

The recent circular sent out by the secretary of the American Society of Mechanical Engineers calls attention to the proposal to increase the dues of regular members from $15 to $25 per year, and the dues of juniors from $10 to $15. As a member of the society, I wish to protest against this increase in dues for the full members. There is probably a large percentage of the membership that are also members of various special engineers' clubs and societies, with varying dues to pay in each. For instance, a member who is engaged in railway work will have (according to the proposed scheme) $25 for the A. S. M. E.; $5 for the Master Mechanics' Association; $4 for the Master Car Builders' Association, and $4 for Railway Clubs, with a probability of other dues, such as the Franklin Institute, International Society on Testing Materials, etc. The sum total of this, it seems to me, runs up rather large, especially for the younger members, whose position and salary are limited.

On the other hand, it would seem to me proper for both the juniors and associate members to pay the same as the regular members—$15 per year. I think this is fully justified by the fact that the junior members receive all the advantages of the association, in the way of publications, etc., that the full members receive; and, moreover, to my personal knowledge, there are a large number of junior members who are eligible for associate or full membership, who stay in the junior grade simply on account of the difference in dues. This does not seem to me to be just or fair to the full members, and if more money is needed by the society for actual expenses, it would seem to me proper to obtain it by increasing the dues of the junior members.

If money is required for building purposes, as it undoubtedly is, it should be raised in some other manner than from the actual dues, as the building itself is of interest largely to local membership only, while members residing at a distance receive little or no benefit from it. It would also seem that those most benefited by a new building should stand the greater burden of expense. There are also, doubtless, members of the society whose financial conditions are such that a donation from them would not be felt appreciably.

I sincerely trust that, before this proposition is voted upon, the members of the society will give it due consideration and look at it from all standpoints, as I do not believe that the proposed increase is wise, as the present dues are already heavy enough. Moreover, when compared with the dues of the railway clubs and the master mechanics' and master car builders' associations, the dues are out of all proportion at present to the amount of literature received, as compared with these other organizations.

F. F. GAINES,
Member A. S. M. E.

UPPER ADMISSION THROTTLE VALVES AND DRY STEAM.

To the Editor:

The importance of taking steam for the cylinders from the highest possible point in a locomotive boiler, is clearly shown by Mr. Howard Stillman, Engineer of Tests of the Southern Pacific Company, in his excellent paper entitled "Some Phases of the Water-Treating Problem," published in the September issue of the American Engineer, page 281.

In the course of his article, Mr. Stillman says: "We find in our most modern locomotive that the lower steam throttle opening is but 26 ins. above the water level when the gauge glass is half full and the engine on level track. The diameter of the boiler shell is 75 ins., and ample steam room is apparently provided, but the tendency to carry water over into the steam cylinders when the throttle opening is so close to the water line is most apparent. . . . I have seen instances in a boiler carrying bad alkali water when the water would leave the gauge glass entirely on opening the throttle to pull out with a heavy train. Evidently the boiling mass tended to follow the direction of a drain on its evaporative capacity, the steam dome in such

case having been placed well ahead on the boiler. . . . The use of some form of steam separator would be suggested were it possible to apply it to the locomotive. Some modification of throttle whereby the openings are raised to the highest possible position above the water line seems the more feasible."

Drawings of two excellent throttle valves fulfilling this condition have appeared in the American Engineer during the past fifteen months, and the object of this communication is to again direct attention to them, in the hope of leading to their more general adoption. One of these throttles, designed by Mr. A. S. Vogt, Mechanical Engineer of the Pennsylvania Railroad, was illustrated on page 170 of the American Engineer for June, 1900; and its application to the "Northwestern" type express locomotives of the Chicago & Northwestern Railway was shown on page 302 of the October number of the same year. Steam is taken from the top of the dome only, which is accomplished by making the throttle hollow, and closing the usual opening in the lower part of the bonnet. The valve being hollow, there is no sacrifice of area, and its height is but 5¼ ins., or about half the usual amount. All who have seen this throttle speak in high praise of it.

The other throttle referred to was patented by Mr. K. Rushton, of the Baldwin Locomotive Works, and is illustrated on page 96 of the American Engineer for March of the current year. The opening in the throttle pipe below the valve is closed by a close-fitting circular plate, and the valve is hollow; steam can therefore enter the pipe under both flanges of the valve, but it is all initially supplied from the space in the dome above the valve, or from a point about 10 ins. higher than the lower steam opening of the ordinary type of throttle valve. It is probable that this increase in height of 10 ins. from the water level to the point of steam intake will appreciably augment the dryness fraction of the steam delivered to the cylinders.

The Hungarian State Railway compound "Atlantic" type express locomotive, exhibited last year at the St. Maurice-Vincennes Annexe of the Paris Exhibition, is provided with double *baffle-plates placed horizontally in the steam dome below the* regulator, and in view of the simplicity and ease of application of this device, and its apparent success in Continental practice, it seems well worthy of a trial in this country.

In the admirable paper entitled "Tests of the Boiler of the Purdue Locomotive," read by Prof. W. F. M. Goss at the last annual meeting of the American Society of Mechanical Engineers, the author says: "The steam delivered by the boiler, tested under constant conditions of running, as shown by calorimeter attached to dome, is at all times nearly dry, the entrained moisture rarely equaling 1.5 per cent., and being generally much less than this." These results are both valuable and somewhat surprising, but it should be remarked that constant running conditions are favorable to a high dryness fraction of the steam; the water level was probably also such as to give the best results, and the quality of the water used is not stated.

Calorimeter tests of a locomotive in heavy road service, subject to the variable demands upon the evaporative power of the boiler which such work necessarily entails, would, in all probability, show a much higher average percentage of moisture in the steam than is indicated by the above experiments, and especially so if alkali or other readily foaming water was used.

The thermodynamic losses resulting from water in the cylinders, and the danger to the cylinder covers, particularly with piston valves, are too well known to require explanation, and when it is considered that an average of five evaporation tests, taken at random by Mr. Stillman, show "that the locomotive boilers in road service were at times forced in the rate of evaporation 126 per cent. above what we would consider their normal 'static' rating," the advisability of using throttle valves of the upper admission type, and the experimental addition of steam baffle-plates, will be readily appreciated.

EDWARD L. COSTER,
A. M. Am. Soc. M. E.

25 Broad St., New York, September 4, 1901.

Very fast time was made November 16 with automobiles over the straightaway course at Ocean Parkway, Brooklyn, N. Y. H. Fournier made a mile in 51 4/5 seconds with a 40-h.p. gasoline machine, the best mile record previous to this being that of Mr. A. Winton on the Grosse Point track at Detroit last October, which was in 1.06 2/5 minute.

OIL FUEL FOR LOCOMOTIVES.

Practice on the Pacific Coast.

By H. B. Gregg, Engineer of Tests, Santa Fe Pacific Railway, San Bernardino, Cal.

The essential equipment for the successful burning of crude oil in locomotives consists of:

A tank fitted with necessary valves and piping for storing, regulating and conducting the oil; a burner that will properly atomize it; a jet of steam or air for the atomizer; a firebox containing the proper brick work, and having an ash-pan with suitable openings to admit air for combustion.

To convert an engine from a coal to an oil burner, remove the grates and grate frames and apply an ash-pan with suitable plates or castings that will form support for brick-work, and having properly arranged air openings, with dampers to regulate the supply of air.

The Brick Work.—This usually consists of a lining of brick on the bottom of the box, a wall at the front of the box built against the flue sheet, but occasionally from six to twenty inches back, thereby forming a combustion chamber in front of the arch; and an arch, shown in Fig. 1, supported on the side walls. These walls extend around the box and form protection for the mud-ring rivets. In some engines, however, the arch brick is supported on studs, in which case the side walls extend up only to a sufficient height to protect the mud-ring rivets, the front wall in both instances being carried up to the arch. The brick arch should be built as low as possible, in order to protect the crown sheet, crown bolts and rivets from overheating.

In the arrangement shown, special attention is called to the comparatively low arch; to the fact that the bottom of the arch slopes away from the burner, so that broken pieces of brick falling down will not lodge in front of the burner and divert the flame; and to the location of the air openings, these being so arranged that the air for combustion is admitted into the lower pan through dampers, passes up through air inlets and into the fire-box directly underneath the arch, thus being heated before coming into contact with the fire-box sheets and flues.

The Burner.—The burner is bolted or clamped to the mud-ring or bottom plate in the center of the box, and set at an angle so that the oil spray will be directed under the arch. Burners in general may be classified as inside and outside atomizers. In the first class the oil and steam are mixed inside the burner, while in the second the oil and the steam do not mix until after leaving the burner. With some burners it is necessary to have a heater box, while others are made with heater and burner combined. In this system a separate heater box is fastened to the frame with the necessary piping. In this arrangement the piping and valves are so connected that live steam can be used to blow out the oil pipes, either through the burner or back through the oil tank.

It has been found by experience that a rigid pipe connection between the heater box and the burner causes the burner to get out of adjustment, due to the expansion and vibration of the pipe. To overcome this difficulty a piece of hose is inserted in the oil pipe line near the burner as shown. The steam for the atomizer and also for the heater is taken from a tee connection in the blower pipe. This pipe branches, one line going directly to the burner for the atomizer and the other through the heater box to the heater coil in the oil tank on the tender. The valves for the atomizer and heater, also the handle for the oil regulating valve, are located on the left side of the engine, convenient for the fireman.

The fire door is fitted with a clamp to hold it tightly closed. It has a hole in the center with an escutcheon plate and wing nut. This aperture is for sanding the flues, which is done occasionally on hard pulls, should the engine show a tendency to lag for steam. This method is very effective in cleaning

the gum off the flues, and is only used three or four times going over a division. The sand is applied through an elbow-shaped funnel made for the purpose. When sand is being applied by the fireman the dampers are closed and the engineer leading to the aperture in the firedoor, the sand being blown into the fire-box by means of an air jet.

An important change in the usual front end arrangement of a coal burner when the engine is equipped for oil is the

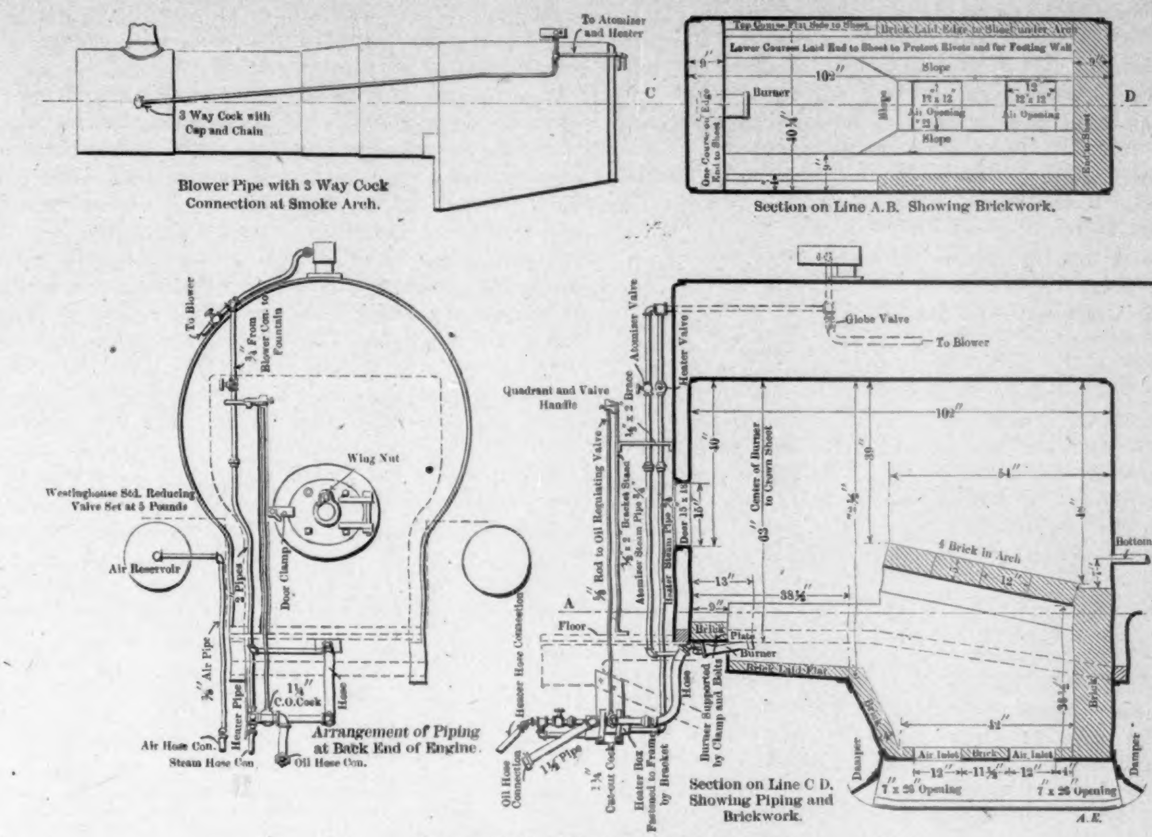


Fig. 1.—Firebox, Brick Work and Piping.

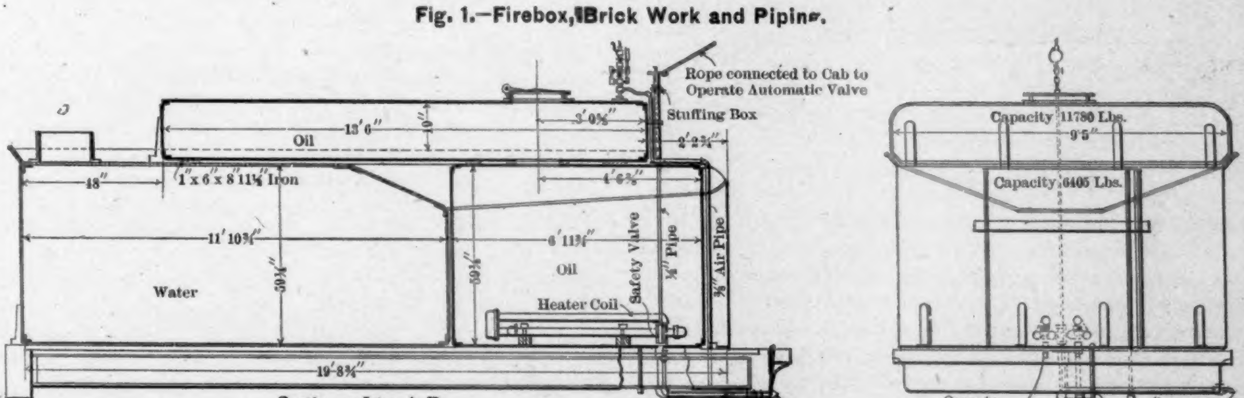


Fig. 2.—Tender, Oil Tank and Piping.

Oil Burning Locomotive—Santa Fe Pacific Railroad.

drops the reverse lever down a few notches, in order to make the sand more effective. The sand supply is carried in a box located on the tender. Another method for sanding flues is to locate the box up in the cab or on the boiler with a pipe removal of all netting and plates. The danger from sparks with oil fuel being practically eliminated, the front end arrangement consists of only the exhaust nozzle, petticoat pipe and straight or choke stack. A special three-way cock, form-

ing the blower pipe connection to the smoke arch, is used in firing up engines in the round house, or where steam or air can be obtained. The three-way cock can be turned so that a part of the steam or air goes up the stack for draft and a part back to the burner to atomize the oil.

Tender Equipment.—The oil storage tank, shown in Fig. 2, consists of two tanks connected, built to apply to a standard coal burner engine tank. The lower one occupies the coal space, while the upper one extends over the water tank. The two tanks combined have a capacity of between eight and nine tons of fuel oil. The lower tank is equipped with the heater coil for heating the oil to proper temperature. Some, however, do not consider this coil necessary, but recommend heating the oil by blowing steam directly into it. The latter method is much quicker, but as water in oil is very objectionable, the heater seems preferable, as with it the condensed steam cannot mix with the oil.

The safety appliances consist of a pop valve set at five pounds, an air gauge, an air-vent valve and two automatic safety valves. One of these, located in the bottom of the tank in the oil outlet, has a stem extending up through the top of the tank and stuffing box, and is held in the open position by an eye pin passing through the stem. This pin is connected to the back of the cab by a small wire or rope, which, in case of a break-in-two between the engine and tender pulls out the pin, whereupon the valve closes automatically and stops

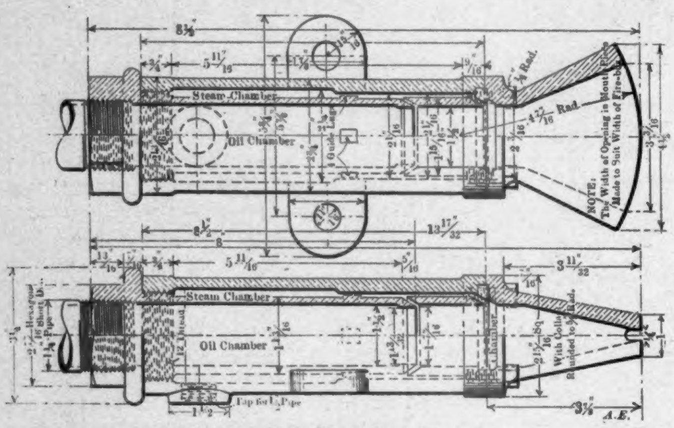


Fig. 3.—Inside Atomizer Burner.

the flow of oil. The other safety valve is in the outlet oil pipe between the tank and the burner, and is also connected to the engine by a chain, which, in case of a break-in-two, automatically closes it. This valve is also used to shut off oil while the engine is standing in the round-house with the fire out, it being operated by a rod extending up through the deck. A Westinghouse reducing valve, adjusted to five pounds, is used in the air line between the air reservoir on the engine and the oil tank. It is sometimes necessary with heavy oil to carry about five pounds air pressure in the oil tank to maintain a uniform flow of oil to the burner. With new equipment it might be preferable to use a combination oil and water tank, in which the oil tank is wholly surrounded by water except on the bottom. This style is safer, but in it the oil is subjected to the cooling effect of the water surrounding it, there being only a single sheet of metal between the two.

Operating Oil Burners.—In the handling of oil, caution must be used in oiling and firing up engines and in examining and repairing empty tanks. In oiling up engines at night do not approach the man-hole of the tank with a lantern or torch for ascertaining the amount of oil in the tank. In firing up engines never open the oil valve before throwing lighted greasy waste into the firebox, being sure that it is burning when the valve is opened. Do not enter the tank for the purpose of examining and repairing it until the oil has been drained and the tank washed or steamed out.

In firing up an oil burner where steam can be had for the blower and atomizer through the connection to the three-way cock on the smoke arch the fire is started by throwing a lighted piece of greasy waste into the firebox, then opening the atomizer valve and starting the oil lightly. After steam forms in the boiler it can be used for the atomizer and blower in the usual way. Where no steam or air is available for the atomizer the fire must be kindled with wood until enough steam has been formed to work the atomizer.

To a fireman used to shoveling ten or fifteen tons of coal into a firebox in going over a division the work of firing an oil burner seems comparatively light, but to keep a uniform steam pressure and a clear stack necessitates close attention, for a change in the position of the throttle or reverse lever, or a difference of speed, usually requires a readjustment of the valves regulating the supply of oil and steam to the burner. In stopping at stations, or when drifting, the fire is cut down by moving the regulating valve handle up against the adjustable stop on the quadrant. This stop is adjusted so that when the valve handle is up against it the oil will be just sufficient to maintain a light flame in order to prevent waste of oil, black smoke and the engine popping off. The fire should not be allowed to go out while the engine is running, as cold air will be admitted into the firebox and injure the sheets and flues. The fire going out can be detected by the milky white color of the smoke coming from the stack. It can also be detected by the odor.

Too much care cannot be exercised in keeping a uniform steam pressure, for with an oil burner the steam pressure can

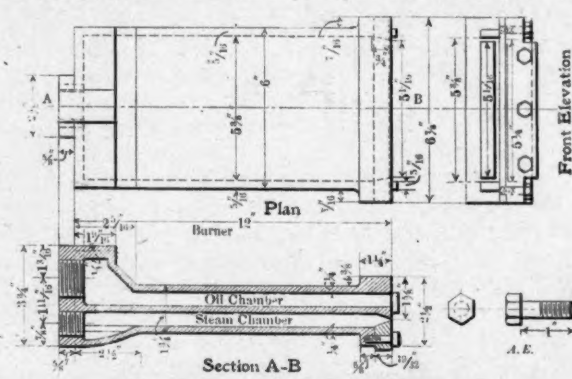


Fig. 4.—Outside Atomizer Burner.

be raised almost instantly, and it is this irregular and over-firing that causes sudden contraction and expansion of the sheets, leaky flues, and in some instances melting the rivets off the inside of the firebox.

As to the road service given by oil burners compared with that of coal burners, the oil burners will usually handle their tonnage better and get over the road with less delay because of having more steam and requiring no cleaning of fires or front ends. It also requires less time to turn engines at terminals, there being no cinders to care for. Engines are oiled by means of a crane and spout. Elevated tanks are used at small intermediate points. These tanks are also used at terminal stations, where the main supply of oil is kept in a large additional tank. The oil is transported from the oil fields in ordinary cylinder tank cars, which are equipped with heater pipes to facilitate unloading. An unloading pit is used to receive the oil from the tank cars into which three cars can be unloaded at one time. From this pit (which will be illustrated in a later issue) the oil runs by gravity into an underground tank, from which it is forced by air pressure to the elevated tanks or into the main storage tank as desired. At places where no air pressure is available the oil is pumped, except in some special cases where the tracks and tanks are so situated that the oil can run by gravity into the storage tanks. In issuing oil to engines, the tanks are all calibrated and a schedule of capacity is calculated for each inch in depth; and the depth of oil in the tank is measured before and after taking oil and entered on a ticket provided for the purpose.

Each fuel station is provided with a copy of the schedule of capacity of each individual tank, from which reports of oil issued to engines are made.

Cost of Oil Equipment.—Following is a detailed statement of cost of labor and material in changing a 20x26 ten-wheel engine from a coal to an oil burner:

Oil reservoir, drilling, tapping, putting in place and securing	$21.60
Automatic valve	3.90
Heater in oil tank	5.20
Heater pipes	1.20
Reducing valve	4.54
Air pipes	6.30
Burner	3.10
Heater box	3.00
Heater hose	1.40
Oil hose	2.15
Stop cocks	1.53
Regulators	2.16
Atomizers and pipes	.95
Brick walls and brick arch	42.25
Oil pipes	.55
Erecting—blacksmith, machinist and laborer	32.50
Removing coal-burning device	3.00
Building and placing ash pan, and material	14.75
Sand box and funnel	2.50
Pop and air gauge	5.06
One set of oil tanks, consisting of two tanks	174.83
	$332.46

In general the comparative cost of handling oil fuel is estimated at 75 per cent less than coal. It is free from starting fires along the right-of-way or setting fire to equipment, and because of its freedom from cinders and black smoke is preferable for passenger service. The additional cost of repairs to brick work, flues and fireboxes, and consequently their shorter lives, is estimated at 25 per cent more in oil-burning engines than the cost of repairs to flues, fireboxes, grates, stacks and front ends in engines burning coal.

The next article on this subject will present the results of tests comparing oil with coal as fuel.

(To be Continued.)

THE STANDARD M. C. B. BOX CAR.

It Has Become a Possibility.

Time seems to cause the greatest difficulties to fade. The desirability of the adoption of a standard box car has long been appreciated, but it has appeared hopeless, because the strong influence necessary to its accomplishment has been lacking. By employing some of the energy and persistence which has resulted in the present admirable system of car interchange, the standard car may now be had in a short time, because the only serious obstacle has been removed by the adoption, last month, by the American Railway Association of the standard inside dimensions of box cars. These are a length of 36 ft., a width of 8 ft. 6 ins., a height of 8 ft., a cross sectional area of 68 sq. ft., and a cubical capacity of 2,448 cu. ft. These dimensions were adopted by the association, with but one dissenting vote, and the following resolution was unanimously adopted: Resolved, That the Master Car Builders' Association be requested to consider and adopt the required external dimensions of the Standard Box Car, based upon the interior dimensions as prescribed by the American Railway Association.

A standard size of 6 ft. as the width of the door openings has an important bearing upon the shipper's side of the question, for it appears that many of them find that this is a necessity. This dimension was settled upon to meet this need. With a large door they are prepared to get along with cars of the standard size.

There have been two obstacles to the standard car. First, the desire of the freight departments to build larger cars than their competitors own, as an inducement for the patronage of shippers; second, the opinion of many officials that their own practice in car design is superior to that of their neighbors. The first of these is removed by the decision of the operating and traffic officials to consider the 36-ft. car the unit for the establishment of minimum carload weights, and the second will be brought before the M. C. B. Association at its next convention. Furthermore, the American Railway Association has determined to continue its efforts and aid in the practical adoption of the standard "to the end that both the best physical and the best commercial results may be accomplished."

Heretofore the shippers have found it advantageous to use the largest cars obtainable, but now the minimum weights become a penalty for the use of cars larger than the standard, and on the other hand, the use of cars smaller than the standard, until they are worn out, is provided for, as will be seen by the text of the new rules, which will be found in another column of this issue. With this preparation the M. C. B. Association will find its problem comparatively simple, and it will probably be taken up in the manner characteristic of that body in dealing with questions of such importance.

In 1896 the late D. L. Barnes said that "no M. C. B. standard of details of the woodwork of cars will ever be agreed upon." This seemed impossible then, but it is possible now. A standard for sections of siding and flooring has already been adopted, and in settling upon the necessary exterior dimensions it will be comparatively easy to extend the standards to sills, posts, braces and other timbers. While there is now a great variety in the distribution of the material, the differences in amounts for cars of the same capacity are not great. It will be necessary to determine a standard sill spacing and construction as to trussing. Fifteen years ago the Chicago, Burlington & Quincy adopted the practice of making the truss rods large enough to carry the whole live load. It should be a simple matter to determine the proper sizes and disposition of sills and truss rods to carry a given load, and practice in this respect would easily become uniform. In this connection the capacities of the standard car become important. It should be decided whether the standard car should be of 40 or 50 tons capacity, and probably both capacities will be provided for. In short, an opportunity is at hand for investigating the entire question of box cars, with a view of providing M. C. B. construction for all the steps from wooden to all-steel underframing.

A careful examination of the dimensions of a number of cars now used successfully in general interchange, leads to the opinion that the standard inside dimensions may be provided for within the limitations of present clearances. There will be no difficulty in keeping within the limits of a width of 9 ft. 10 ins. at the eaves, and a height of 12 ft. 6 ins. from the rail to the eaves. These dimensions have already been used for years for 30-ton cars. When the side bearing vs. center plate method of support is decided, it may be possible to obtain the 8-ft. inside height, with a lower roof than is now used. It may also be possible to save several inches in height by introducing pressed steel carlines.

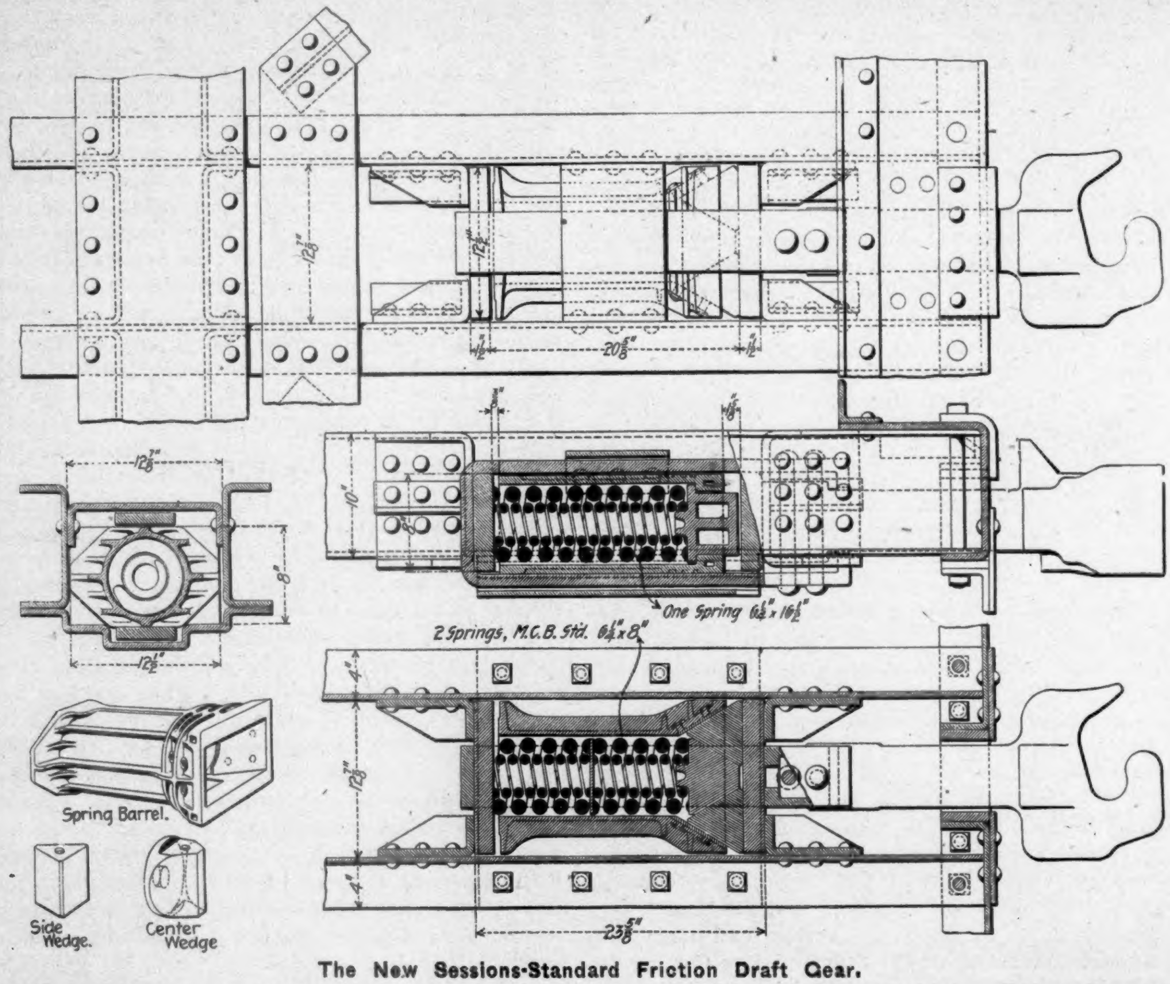
As the standard car question now stands it is necessary for the car builders to act, because one of the primary objects of the American Railway Association was to pave the way for car construction which shall enable the railroads to obtain the benefits from the better market conditions with regard to standard timbers and the reduction of the delays in repairs now caused by the absence of such standard sizes. Careful estimates place the effect of this as amounting to a virtual increase of 5 per cent. in the amount of car equipment available for use. If lumbermen are called upon to furnish only standard timber and other lumber, they will be able to cut it specially for car work, and this must affect both the time of deliveries and the price. The difference in the items of siding and flooring has been placed at $1 per thousand. It may be even greater when all the wooden members are standardized.

If the standard car should tend to check development or progress in new ideas it would not be an unmixed blessing, but sufficient scope for development seems to remain in such items as the trucks, bolsters, draft gear, brake beams and roof coverings. In larger matters the association will be able to keep the standard abreast of all improvements. This will be a comparatively simple matter with the sizes once established, and the problem is one of construction only, whether the material is wood or steel, or both. Other types of cars may be given the same treatment in their turn. In this work, beginning with the box car, the Master Car Builders' Association will find a field worthy of its skill and traditions. This movement accomplished, the introduction of per diem charges for the use of cars may be undertaken.

THE NEW SESSIONS-STANDARD FRICTION DRAFT GEAR.

The Standard Coupler Company.

This new draft gear is the result of a series of improvements upon the original design of friction draft gear by this company, which was illustrated on page 122 of our April number. It employs the friction principle of increasing the effectiveness of the springs, but instead of increasing the recoil, as would result from increased spring capacity alone, the recoil is actually reduced. This improvement employs standard springs and the usual arrangement of parts, it does not require special sill construction, and it effects the friction principle with the addition of but four parts to the number required by an ordinary spring gear. In the engravings are shown sectional views of the gear itself, the method of attachment to steel and wooden underframes, and details of the cheek plates and stop castings used with wooden cars.



The New Sessions-Standard Friction Draft Gear.

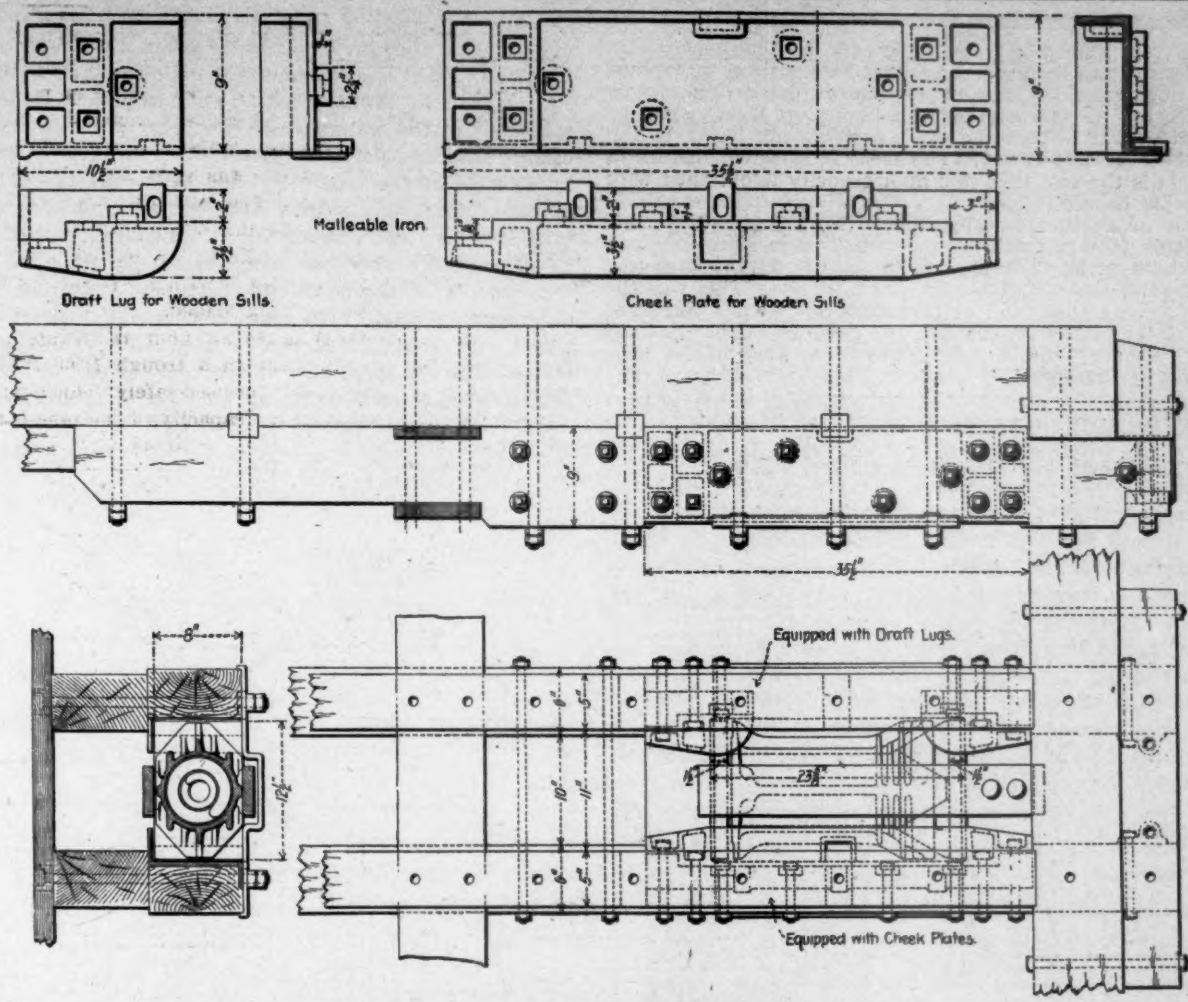
The complete gear is shown as attached to draft construction which has been used extensively in steel cars. Either two standard M. C. B. draft springs or a single long spring of the same diameter as the standard may be used. Both arrangements are shown in the drawing. The springs are placed in a substantially ribbed malleable iron barrel through which the end of one of them projects ⅜ in. toward the left-hand follower. The other end of the other spring bears against a central wedge, and between the bearing faces of this central wedge and bearing surfaces at the bell end of the barrel, two triangular wedges bear. Against the outer faces of these latter wedges the forward follower rests. In placing the parts together, the springs are given a slight initial load.

In service the followers tend to approach each other in both pulling and buffing. The first movement of ⅜ in. acts upon the springs alone, because of the clearance space left at the end of the barrel. As soon as this motion is taken up the left-hand follower bears on the barrel, and the other one, being against the wedges, presses the wedges into the bell mouth of the barrel and compresses the springs within the barrel. The parts are so made that the springs cannot be closed solid, because the cylinder is of such a length as to take the load of the followers in direct compression of itself when the wedges have moved almost to the point where the springs would close. The springs, therefore, ought to last indefinitely if made of proper material and of correct size. Angles have been chosen for the wedges which will prevent sticking. The outer wedges are in the form of equilateral triangles and may be put in without regard to the wearing surfaces. All three wedges are of cast iron with chilled faces. They are cheap and should wear well. Cast steel wearing plates are riveted to the mouth of the barrel to take the wear from the wedges, thus placing all of the wear upon easily renewed parts. With 2-in. motion of the followers the total spring motion, including the preliminary motion and the ¼-in. initial compression, is 3⅝ ins. On the wedges the multiplication of the motion is 2 to 1. The wedges have a free movement of 1⅝ ins.

This gear may be placed between sills which are 12⅞ ins. apart, and in the wooden sill attachments two methods are shown, one having cheek plates and the other with stop castings. The large area of the shoulders of these should be noted. They amount to nearly the total sectional area of the draft timbers. In the attachments the method of support is simple.

As stated, a single long spring may be used if desired. This permits of increasing the spring capacity by substituting 1 5/16 and ¾-in. rods for the standard sizes. This alternative saves two pieces—the second spring and the separating plate. There may be an advantage in the cost in favor of the single spring.

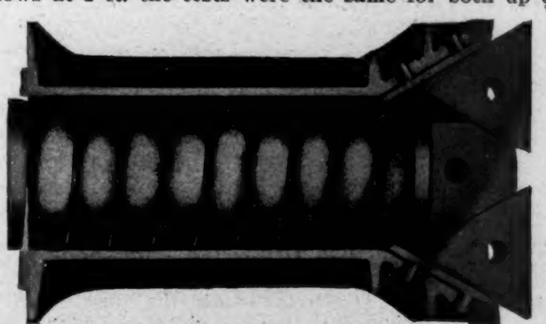
Remarkable tests have been made upon this gear by a well-known railroad official, in whose judgment and impartiality



Showing Attachments for Wooden Cars.

we have every confidence. This gear and a twin spring gear of the usual type were mounted in draft attachments intended to represent the strongest construction in use under steel cars. The gears were mounted centrally with the draft sills, and in order to prevent deflection of the webs of these sills, bracing was applied. Otherwise the attachments were as shown in the complete draft gear in the large engraving. These gears were then tested under a 1,640-lb. drop, with the results indicated in the accompanying record.

In the friction gear test the first two blows were not counted; they were given to bring the parts up to a bearing; but after the blows at 2 ft. the tests were the same for both up to the



Sectional View, Showing Spring Barrel, and Wedges.

tenth and twelfth blows. It is noteworthy that the twin spring gear was closed solid and the destruction of the steel sills was begun by blows which only brought the other gear to a bearing. At the end of both tests the channels were badly crippled, notwithstanding the lateral bracing. Clamps were located 11½ ins. below the face of each draft lug to prevent spreading, and 4 ins. above each of these another was applied to prevent buckling. The ends of the sills were badly crushed where they rested upon the anvil. Notwithstanding that these tests were sufficient to wreck a steel car, the friction gear, when removed, was in perfect condition.

In the tests of the friction gear the maximum recoil of the weight was but 8 ins., and usually there was but one recoil. It is apparent that the effect of the wedges (the springs were alike in both tests) was to change the point of solidity of

Sessions—Standard Friction Draft Gear.

No. of blow.	Height drop.	Movement of followers.	Remarks.
1	5 ft.	1 9/16 ins.	Preliminary to loosen parts to working condition.
2	5 ft.	1 9/16 ins.	
3	1 ft.	⅝ in.	
4	2 ft.	1 in.	
5	3 ft.	1 3/16 ins.	
6	4 ft.	1⅜ ins.	
7	5 ft.	1 9/16 ins.	
8	5 ft.	1 9/16 ins.	
9	6 ft.	1¾ ins.	
10	6 ft.	1¾ ins.	
11	7 ft.	1⅞ ins.	
12	7 ft.	1⅞ ins.	Slight backing of web at draft lug, visible on one side.
13	8 ft.	2 ins.; Gear closed.	No change apparent.
14	9 ft.	"	Both sides showed slight buckling of channel web.
15	10 ft.	"	No change apparent.
16	11 ft.	"	Web buckled ⅜ in.; flanges contracted ½ in.
17	12 ft. 3 ins.	"	Webs buckled 7/16 in.; flanges contracted 9/16 in.
18	12 ft. 3 ins.	"	Webs buckled 9/16 in.; flanges contracted 9/16 in. and buckled vertically.
19	12 ft. 3 ins.	"	Sills badly distorted, equivalent to a bad wreck.

Twin Spring Gear.

No. of blow.	Height drop.	Remarks.
1	2 ft.	Springs closed solid.
2	3 ft.	
3	4 ft.	
4	5 ft.	Channels commenced to fail.
5	5 ft.	Channel failure increased.
6	6 ft.	Channel failure increased.
7	6 ft.	Channel failure increased much greater.
8	7 ft.	One side damaged so as to cause gear to lean out of plumb.
9	7 ft.	Damage continued as above.
10	8 ft.	Condition of channels about the same as when removed at end of test with Sessions Gear.

the gear from a drop of 2 ft. to one of 8 ft. This means that the wedges act to increase the height of the drop to exhaust the Sessions gear to four times that of the ordinary gear before closing it. One of the most important facts shown by the friction gear is that the draft attachments began to fail before the gear was closed. The most remarkable feature of these tests is the fact that this high capacity is obtained with such simple construction.

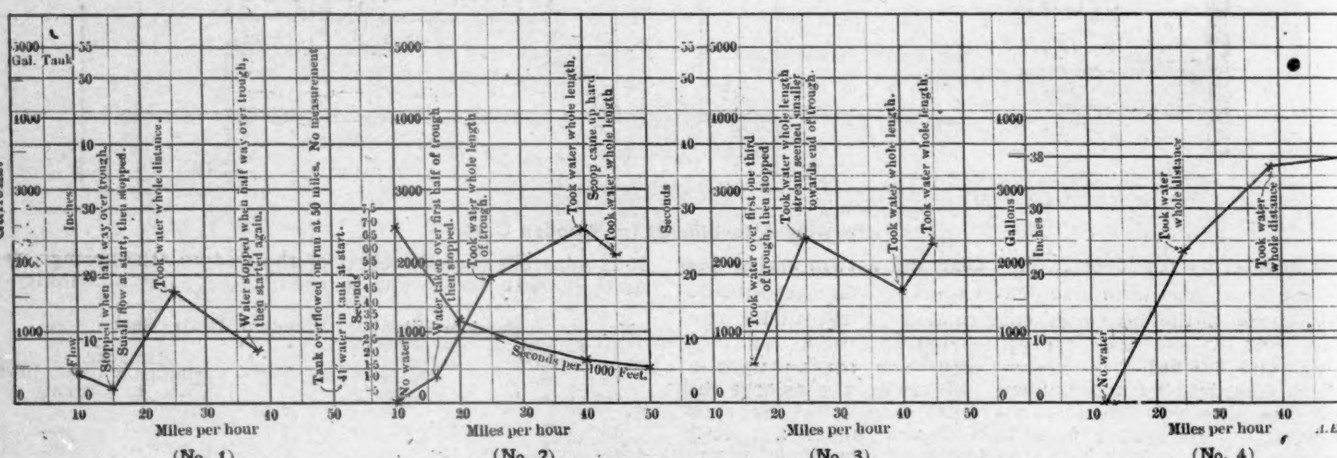
Records of another test by Robert W. Hunt & Co., made on a Riehle 150-ton machine, show that when equipped with two 6¼ by 8-in. M. C. B. springs the elastic limit of the gear was not quite reached at a load of 125,200 lbs. This was the average of four tests, and at this load the springs were not closed. After taking 300,000 lbs., the limit of capacity of the machine, the gear was in perfect condition, with no deformation of the spring barrel.

EXPERIMENTS WITH TRACK TANK SCOOPS.

New York Central & Hudson River Railroad.

It is apparent that the track tank is becoming more and more necessary for both freight and passenger equipment on roads having congested traffic. Improvement of practice in this regard has been recorded in these pages, and we are now permitted to present the results of some experiments made last year on the New York Central & Hudson River Railroad, which led up to the design of water scoop which was illustrated on page 143 of our May issue of this year.

These experiments were undertaken in a study of the different forms of water scoops which were then in common use, and included the practice of four different roads. They were carried out on west-bound track No. 2, at Schenectady. The trough used is 1,400 ft. long and 7 ins. deep, its top being at about the height of the top of the rail. The different scoops were fitted to tenders, which were drawn over the trough at various speeds, and the amount of water taken at each speed was measured in the tender tank. The measurement of speed and of water taken was not done with the idea of being scientifically accurate. In a length of 1,400 ft. there was a difference of elevation of 3 ins. in the level of the trough. In this case this was due to the fact that the trough was new and the ballasting was not completed. This, however, represents the condition of troughs which may be seen in actual use. This difference of level explains the notations on the first three diagrams, showing that at the slow speeds water was taken over the first third or half of the trough, and that the flow stopped when the water became shallow.

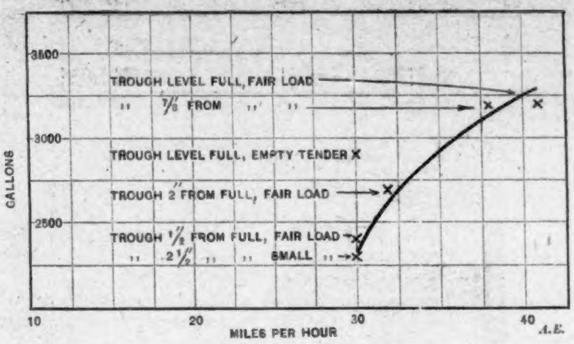


New York Central Experiments With Track Tank Water Scoops.

Diagram No. 4 was taken from a scoop which was illustrated on page 283 of our November issue of 1896. The line at the inside lower edge of the mouth was 4⅛ ins. below the top of the rail, and the record was taken with the tender half loaded with water and fully loaded with coal. This scoop does not splash the water beyond the rails at speeds as high as 50 miles per hour, which explains its excellent action.

Test No. 1 was made with a scoop having a shield. It will be noticed that in Nos. 1, 2 and 3 the curves are irregular, indicating that the amount of water taken did not increase uniformly, and that less water was sometimes taken at the higher speeds than at lower speeds. This is probably due to the splashing of the water, which was very great in these three cases. Diagram No. 1 was taken with the line at the inside lower edge of the scoop, 2½ ins. below the top of the rail, diagram No. 2 was with a different scoop, having this distance 2¾ ins., and diagram No. 3 with a distance of 3⅝ ins., all of these three tenders being loaded.

At speeds of about 25 miles an hour it is safe to count upon getting about 2,000 gals. in a trough 1,400 ft. long, of which only about 1,200 ft. can be used safely. This quantity increases with the speed until the capacity of the pipe is reached, and at from 40 to 50 miles an hour about 3,500 gals. may be



No. 5.

taken when the scoop dips into the water about 2 ins., this being the average distance, which will vary in accordance with the height of the tender and the level of the water in the tank.

It will be remembered that the new water scoop on this road differs from those with which many old locomotives are equipped by the omission of the top wall and hood. On the Lake Shore, the New York Central and the Pennsylvania, the practice is to omit these parts to reduce the splashing.

A test of the new scoop, when plotted, gave the curve shown in No. 5, which does not include high speeds. These curves are interesting in connection with the discussion of the theory of water scoops by Professor Church, which appears elsewhere in this issue. One of the great difficulties with track troughs is to keep them level. They must be given constant attention where water is taken from them frequently, because considerable water is wasted each time the scoop is used, and provision must be made to get this water away from the roadbed. The open-top scoop wastes much less water than do the scoops of earlier design, and hence, by their use the cost of maintenance of the track trough is very materially reduced.

We are indebted to Mr. A. M. Waitt, of the New York Central, for the privilege of printing these diagrams.

For previous references to track tank scoops see the following numbers of this journal: November, 1896, page 283; July, 1900, page 211; November, 1900, page 344, and May, 1901, page 143. This issue, page 376.

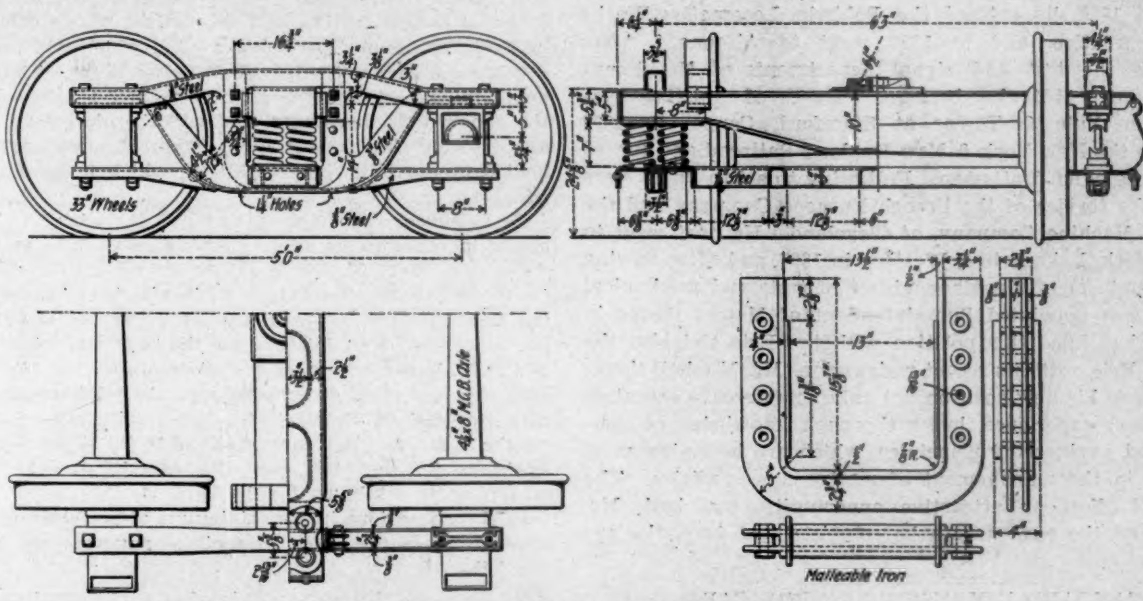
PRESSED STEEL TRUCK

For Cars and Tenders,

Pere Marquette Railroad.

Mr. B. Haskell, Superintendent of Motive Power of the Pere Marquette, has designed and patented the construction of pressed steel trucks, which, by his courtesy, are illustrated in these engravings. These trucks are arranged for cast steel and also pressed steel bolsters; the latter is selected for illustration.

The object was to employ pressed steel in the arch bar type of construction, which would be simple and would not require column bolts and rivets. It is believed to be amply strong, and it employs no rivets except those attaching the spring plank to the bottom bar and those securing the short tie pieces.



Pressed Steel Truck—Pere Marquette Railroad.

The arch bar frames are of pressed steel in U section, with the flanges of both parts turned toward each other. At the ends over the boxes the upper bar is flanged to a width which permits it to cover the ends of the lower one, and a filling casting is placed between them, through which the box bolts pass. At the opening for the end of the bolster the pressed steel portions are bolted to malleable filling blocks, which are shown in the detail view. These serve to stiffen the frames at these points and they also act as distance pieces for the bolts. The spring planks are also of pressed steel. From the inverted arch bar, the pieces of pressed steel extend to the boxes and receive the lower ends of the box bolts. For the side frames the steel plate is ⅜ ins. thick, and for the spring plank 5/16 in. In case it is necessary to take out the bolster, the journal box bolts are removed and also those attaching the upper member of the side frame to the casting forming the connection between the upper and lower bars. This design uses 4¼ by 8-in. journals and will first be used under box cars.

Because Mr. T. H. Symington has become connected with the Gold Car Heating Company, the impression has been received that he has severed his connection with T. H. Symington & Co., of which he remains as President. Pending the completion of tests of their specialties in various parts of the country, the business of this company will be conducted as heretofore, from the Baltimore office, under the direct supervision of Mr. Harvey Middleton, managing director. Mr. W. R. Bean has been appointed general inspector of the company, and will have charge of these tests.

PERSONALS.

Mr. E. A. Faulhaber, Treasurer and Purchasing Agent of the Tennessee Central, has removed his headquarters from St. Louis, Mo., to Nashville, Tenn.

Mr. N. B. Whitsel has been appointed Master Mechanic of the Northern Division of the Grand Trunk, with headquarters at Allendale, Ont., in place of Mr. T. A. Summerskill, resigned.

Mr. C. M. Taylor, Master Mechanic of the Atchison, Topeka & Santa Fe at La Junta, Colo., has been appointed Master Mechanic of the Rio Grande & New Mexico Division, with headquarters at Raton, N. M.

Captain A. L. Fowler has been appointed Eastern Manager of the "Railway and Engineering Review," succeeding Mr. R. A. Bagnell, resigned. Captain Fowler will have charge of the eastern office in New York.

Mr. F. N. Risteen has been appointed Assistant Superintendent of Motive Power of the Chicago Great Western. Mr. Risteen was formerly Master Mechanic of the Fargo division of the Northern Pacific at Fargo, N. Dak.

Mr. T. A. Summerskill, Master Mechanic of the Grand Trunk at Allendale, Ont., has been appointed Superintendent of Motive Power of the Central Vermont, with headquarters at St. Albans, Vt., to succeed Mr. William Hassman, resigned.

Mr. E. M. Roberts has been appointed Superintendent of Motive Power of the Detroit Southern, with headquarters at Detroit. He was formerly Superintendent of Motive Power of the South Carolina & Georgia.

Mr. R. A. Bagnell has resigned as Advertising Manager of the Eastern department of the "Railway and Engineering Review," a position which he has held for the past three years, to accept the appointment of Western Manager of the Pocket List of Railway Officials, with headquarters in Chicago.

Mr. Ashbel Green, Purchasing Agent of the Manhattan Railroad Company, has resigned to connect himself with Thornton N. Motley & Co. Mr. Green was formerly connected with the West Shore and New York Central railroads. Mr. J. H. Canepe, Acting Supply Agent, is now filling the office of Purchasing Agent of the road.

Mr. Benjamin Johnson, Engineer of Tests of the Atchison, Topeka & Santa Fe, has resigned to accept the position of Superintendent of Motive Power and Machinery of the Mexican Central, succeeding Mr. F. W. Johnstone. Mr. Johnson entered the service of the Santa Fe as a machinist in 1879, and remained in the locomotive department in various capacities until 1888, when he accepted a position with the Westinghouse Air-Brake Company. In 1898 he returned to the "Santa Fe" as Division Master Mechanic, and since June, 1900, has been Engineer of Tests.

Mr. A. E. Mitchell, who for nine years has been identified with the Erie Railroad as Superintendent of Motive Power, has resigned to become Assistant Superintendent of Motive Power of the Chicago, Milwaukee & St. Paul, with headquarters at West Milwaukee. Mr. Mitchell has had an unusually wide and successful experience, which will be exceedingly valuable to the road whose service he enters. After graduating in mechanical engineering from the Maine State College in 1875, he entered the Baldwin Locomotive Works as an apprentice, and in 1877 went to Altoona. After serving in the test and signal departments of the Pennsylvania until 1881, he became designer of hoisting machinery for Yale & Towne at Stamford, Conn. In 1882 he went to the New York & New England Railroad and served until 1884 as chief draftsman. Following this two years were spent in the service of the French Furnace Company and the Arctic Ice Machine Company, of Cleveland. He next went to the New York, Lake Erie & Western in 1887, and after serving there as engineer of signals, engineer of tests and mechanical engineer, was appointed Superintendent of Motive Power in 1892. He has filled this position with the Erie and also the Chicago & Erie until his recent resignation. Mr. Mitchell therefore brings to his new position not only an extensive executive motive power experience, but a thorough knowledge of commercial and engineering principles, which are becoming most important in the management of motive power affairs. The "St. Paul" offers an attractive opportunity, and both Mr. Mitchell and the road are to be congratulated upon the appointment.

STANDARD DIMENSIONS OF BOX CARS.

American Railway Association.

At the recent St. Louis meeting of the American Railway Association the standard box car was advanced by an important step, which removes the greatest obstacle to its accomplishment. At that meeting a report was presented by a conference committee, which is reproduced in full as follows:

The Committee on Standard Dimensions of Box Cars respectfully presents the following report: It held a session at Mackinac Island, Mich., on August 21 and 22, 1901, at which time there were present by invitation the following representatives of traffic associations: Mr. C. E. Gill, Chairman Official Classification Committee; Mr. J. T. Ripley, Chairman Western Classification Committee; Mr. P. J. McGovern, Chairman Southern Classification Committee; Mr. John Earls, Chairman Classification Committee of the Canadian Freight Association.

Under the resolution of the association passed April 24, 1901, your committee was requested to confer with the representatives of the various traffic associations, and the recommendations herewith submitted are the result of the action of this joint conference.

A standard car of the dimensions of 36 ft. in length, 8 ft. 6 ins. in width, and 8 ft. in height, was originally favored. It was subsequently stated that cars 8 ft. in height could not be transported over certain important lines, and the height was therefore made 7 ft. 6 ins. This was adopted by the Association in April, 1901.

On April 24, 1901, the following principle was approved by the association:

"That the essential elements of the standard box car require the height and width to be as great as are permitted by the physical limitations of the important railroad clearances and the present established height of loading platforms; that the length be determined by economy in construction, maintenance and operation and the requirements of economical stowage."

The objections to the car 8 ft. in height have now been withdrawn, and in pursuance of the principle above enunciated the following resolution is offered for adoption:

(1) Resolved That the dimensions of the standard box car be 36 ft. in length, 8 ft. 6 ins. in width, and 8 ft. in height, all inside dimensions. Cross-section, 68 sq. ft.; capacity, 2,448 cu. ft. The side door opening to be 6 ft. in width.

After a thorough discussion of all phases of the question as affecting both the transportation and traffic departments, the following resolution was approved and recommended for adoption:

(2) Resolved, That the standard 36-ft. car be considered the unit for the establishment of minimum car-load weights; and that where necessary in any classification territory to recognize cars under 36 ft. in length, it shall be by a reduced minimum of 2½ per cent. for 35-ft. cars and 5 per cent. for cars 34 ft. or under, inside dimensions.

In the opinion of the conference committee, cars exceeding the standard dimensions are uneconomical and undesirable vehicles of transportation, and they ought not to exist. As they do exist, minimums are recommended which will permit of the use of such cars until they shall be worn out. The rate of increase of the minimum is slightly greater than the increase in the capacity of these cars, and will therefore tend to discourage their further construction. These figures have been embodied in the following resolution, which is recommended for adoption:

(3) Resolved, That for cars over 36 ft. in length the percentage of increase of the minimum weights shall be as follows:

For cars of 37 ft. and 38 ft., 10 per cent. over the minimum for the 36-ft. car. For cars of 39 ft. and 40 ft., 25 per cent. over the minimum for the 36-ft. car. For cars of 41 and 42 ft., 40 per cent. over the minimum for the 36-ft. car. For cars of 43 and 44 ft., 55 per cent. over the minimum for the 36-ft. car. For cars of 45 and 46 ft., 65 per cent. over the minimum for the 36-ft. car. For cars of 47 and 48 ft., 70 per cent. over the minimum for the 36-ft. car. For cars of 49 and 50 ft., 80 per cent. over the minimum for the 36-ft. car. For cars of over 50 ft., 150 per cent. over the minimum for the 36-ft. car.

As the alterations in the minimums above recommended may affect the revenue, your committee suggests the passage of the following:

(4) Resolved, That any diminution of revenue incident to the minimum proposed in the accompanying schedule shall be adjusted in the rate.

With improved methods of construction the carrying capacity of freight-car equipment has been constantly increasing. It is therefore recommended:

(5) Resolved, That the minimum car-load weights of heavy articles, such as iron, brick, lumber, minerals, etc., should, as fast as practicable, be advanced to the stenciled capacity of the car.

In order that the growth of the evil now under consideration may be effectually checked, the following resolution is recommended for adoption:

(6) Resolved, That no box cars of larger dimensions than those prescribed for the standard car shall be hereafter constructed, and that all owners and builders of cars be officially notified of the adoption of this resolution.

For the purpose of reference, the statistics published with the previous report of the committee on standard dimensions of box cars, together with some since obtained, are attached hereto.

These conclusions of the conference committee, which were unanimously adopted, are herewith submitted as the report of your committee to the association.

The following gentlemen were members of the committee on standard dimensions of box cars: J. J. Turner, Fourth Vice-President Pennsylvania Lines West of Pittsburgh; A. M. Waitt, Superintendent of Motive Power and Rolling Stock, New York Central & Hudson River Railroad; G. W. Rhodes, Assistant General Superintendent, Burlington & Missouri River Railroad in Nebraska; S. T. Crapo, General Manager Pere Marquette Railroad; J. J. Frey, President Florence & Cripple Creek Railroad; F. D. Underwood, President Erie Railroad; A. W. Johnston, General Superintendent New York, Chicago & St. Louis Railroad.

This report was adopted with but one dissenting vote, and then the following resolutions were adopted unanimously:

Resolved, That the Master Car Builders' Association be requested to consider and adopt the required external dimensions of the standard box car, based upon the interior dimensions as prescribed by the American Railway Association.

Resolved, That the committee on standard dimensions of box cars be continued for the purpose of aiding in the practical adoption of the standards which it has proposed, and which have been approved by the association, and that the chairman of the several classification committees be requested to act with the committee on standard dimensions of box cars, to the end that both the best physical and the best commercial results may be accomplished.

Comment upon these important steps will be found elsewhere in this issue.

FOUR-POLE ENCLOSED MOTORS.

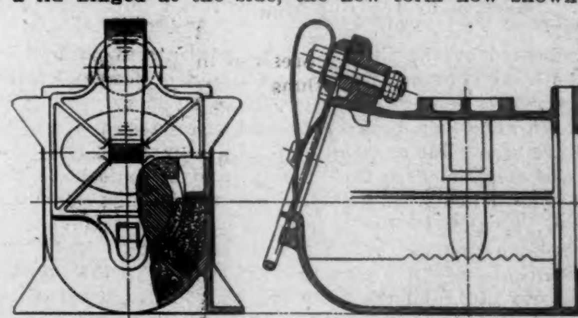
The accompanying engraving illustrates a type of enclosed motor intended to fill all requirements for a high class medium speed machine, with all the latest and most improved features of construction. This type of machine is used by the B. F. Sturtevant Company, of Boston, in a line of bi-polar enclosed motors ranging from ¼ to 5 horse-power, inclusive, and has also been designed to complete the series, four sizes of 4-pole enclosed motors ranging from 7½ to 20 horse-power. The magnet frame of these machines is of special magnet steel and has the field cores cast with the frame. On the small sizes the ring is cast in one piece, but in larger sizes it is split to facilitate the removal of the armature, so as to reduce the weight of each individual part. The pole shoes are of cast-iron, secured to the field cores by cap screws, and are detachable to allow the field coils to be easily repaired if necessary. The bearings are of the ball-and-socket type of ring-oiling, self-aligning construction and are formed in the hemispherical

A Four-Pole Enclosed Motor.

cover casings, which are attached to the magnet ring, one upon either side. The front casing is provided with closely fitting doors which afford ready access to the brushes and other parts of the motor. The entire machine is thus rendered absolutely dust-proof and practically water proof. A removable cap is attached to the centre of the casing at the end of the shaft. In the design of this motor special care has been taken to provide for the most perfect circulation of air through the commutator and armature, and for ample radiating surface in the casings, so as to avoid all possibility of overheating. As a result machines of this type can be operated constantly for ten hours at full rated load without sparking, and with a temperature rise not exceeding 50 degrees Centigrade above that of the surrounding atmosphere. Ventilation is effected by the use of specially constructed air ducts which connect with radial ducts between the laminæ of the core. These convert the armature into a blower and create a strong draft through the windings. The winding for low voltage machines is of copper bars with easy bends. High voltage machines are wire-wound with machine-formed coils. The commutator consists of drop forged segments of pure copper secured by cast-iron flanges of spider construction which allow free circulation of air. All machines are fitted with carbon brushes mounted on holders of the sliding socket type.

AN IMPROVED JOURNAL BOX LID.

On page 292 of our September number an illustrated description of the new journal box of T. H. Symington & Co. was printed. In order to provide for blows which would damage a lid hinged at the side, the new form now shown was



The New Symington Journal Box Lid.

developed on the same principle as the previous one. This lid has a machined joint, and the spring gives it a heavy central pressure, the spring being locked between the ends of a pivot bolt, but the hinge is upon the top of the lid, which will protect it from damage. The lid, if struck, will merely open and not break from a side blow. The lug at the bottom of the box for holding the lid in a central position when closed is slightly tapered on the sides, so that it will slide freely. In this construction no weight comes upon the pivot bolt, because the lid is supported by the solid lugs on the box and lid. The nut which forms the head of the pivot bolt is riveted in place by a ¼-in. rivet, which must be cut in order to remove this bolt. This form of lid has been adopted as standard by this company. Mr. Symington has sent us a set of his printed instructions for the moulder and core maker in making these boxes and also blanks for service records and tests of the boxes. These give the impression of completeness, and they indicate a desire on the part of the manufacturers to promote the practice of keeping careful records of the performance of these devices. The description of the box itself, already referred to, applies to the new standard, which is not changed, except as to the attachment of the lid. The address of T. H. Symington & Co. is Fidelity Building, Baltimore, Md.

BOOKS AND PAMPHLETS.

The Practical Engineer Pocket Book. The Practical Engineer Electrical Pocket Book, 1902. Published by The Technical Publishing Company, 31 Whitworth street, Manchester, England. Price, 1s. 6d. for each.

These handy little volumes are revised annually by the publisher of "The Practical Engineer." They give a large amount of information which is not usually found in pocket books, except the most expensive. These are sold at a low price, which cannot possibly cover the cost of printing and binding. The presence of advertisements may therefore be forgiven. The "Pocket Book" is now in its fourteenth edition and includes new matter with reference to gas engines which will be useful to designers and users of these engines. It also contains new matter concerning the use of Mond gas on a commercial scale. Among new features are sections dealing with mechanical refrigeration, photo-copying of drawings and motor vehicles, these having been treated by men specially versed in these subjects.

The "Electrical Pocket Book" is of the same general character as its older companion. It now appears in its third edition, containing many additional tables and presenting tables and other information concerning wiring, electrical machinery and power transmission.

Parallel Table of Logarithms and Squares, of Feet and Inches. By Constantine Smoley. Size, 5 by 6 ins. 212 pages. Price, $3.00. Published by the Engineering News Publishing Company, New York, 1901.

As indicated by the title, the book presents in parallel columns both the squares and the logarithms, of feet and inches, from zero to 50 feet, by steps of 1/32 of an inch. This is the first appearance in a book of this scope of a case where the steps have been made so small as 1/32 of an inch. It is believed that it is also the first time that the logarithms have been given in parallel columns with the squares. This latter feature, of course, greatly facilitates all computations involving the foot, the inch and the customary division of the inch. The book also contains a five-place logarithm table of the numbers from zero to 1,000, and the more important mathematical constants with their logarithms. Several pages are devoted to an explanation of the logarithms and numerous problems worked out illustrating the applications of the main tables of the book. On the whole, it is a valuable addition to that class of reference books that makes for accuracy in results and economy of time for the engineer or architect.

Master Car Builders' Association. Proceedings of the Convention of June, 1901. Edited by the Secretary, Mr. J. W. Taylor, 667 The Rookery Building, Chicago.

This volume contains the usual information concerning membership, standing committees, subjects for the next convention, the constitution and the proceedings of the recent convention. This year the record covers 597 pages and 30 folded plates of the standards and recommended practices of the association. Among other subjects it includes important reports on coupler tests and draft gear, with the discussions. It is the largest volume ever published by the association, and is in the customary style and binding. Considering the fact that the results of the letter ballot are included in the volume, it appears in a remarkably short time after the convention.

Manning, Maxwell & Moore, Catalogue for 1902. An Illustrated Catalogue of Railway, Steamship, Machinist, Factory, Mill and Electric Supplies. Size, 9 by 12 ins.; 1,056 pages. Published by Messrs. Manning, Maxwell & Moore, 85 Liberty street, New York.

One of these subjects alone would require a large volume, but the representation of all of these branches of mechanical activity in one catalogue results in a work of magnificent proportions which undoubtedly has no parallel in industrial literature. An idea of its comprehensive character is obtained from a glance at the 38-page index of this catalogue. It contains illustrated descriptions and instructions for ordering all of the supplies ordinarily required in the various lines mentioned, and nothing could reflect the character and importance of such a firm as does a catalogue of this kind. Their catalogue of machine tools issued in the current year covers over 700 pages and supplements the present volume.

Transactions of the American Institute of Mining Engineers, Vol. XXX.—These papers are of the usual interest and value, and deal particularly with: 1st, Ores and minerals as regards their origin, formation, development and distribution, as well as various methods of mining. 2d, Metallurgical data regarding cast iron, especially as to its structure, with excellent illustrative photomicrographs, and concerning influence of silicon. 3d, Chemical investigations, including a comprehensive study of the electromotive force of metals in cyanide solutions, with results from the modern electrolytic theory. 4th, Surveying instruments, mining and solar, with cuts showing the gradual evolution up to the present time.

Methods of Chemical Analysis and Foundry Chemistry. By Frank L. Crobaugh. Published by Whitworth Bros. Co., Cleveland, O., 1901. Price, $1.50.

The book gives a concise and simple statement of many of the best standard methods in present use in iron and steel laboratories, and also a statement of the influence of chemical composition upon the qualities of cast iron, with general information regarding foundry practice. It is a useful reference book for any iron or steel chemist.

Poor's Manual for 1901. Thirty-fourth Annual Number. The Handbook and Official Organ of the Railroad System of the Country and of Every Interest Connected with It. Royal octavo, cloth, 1,900 pages, with maps. H. V. & H. W. Poor, 44 Broad street, New York. Price, $10.00.

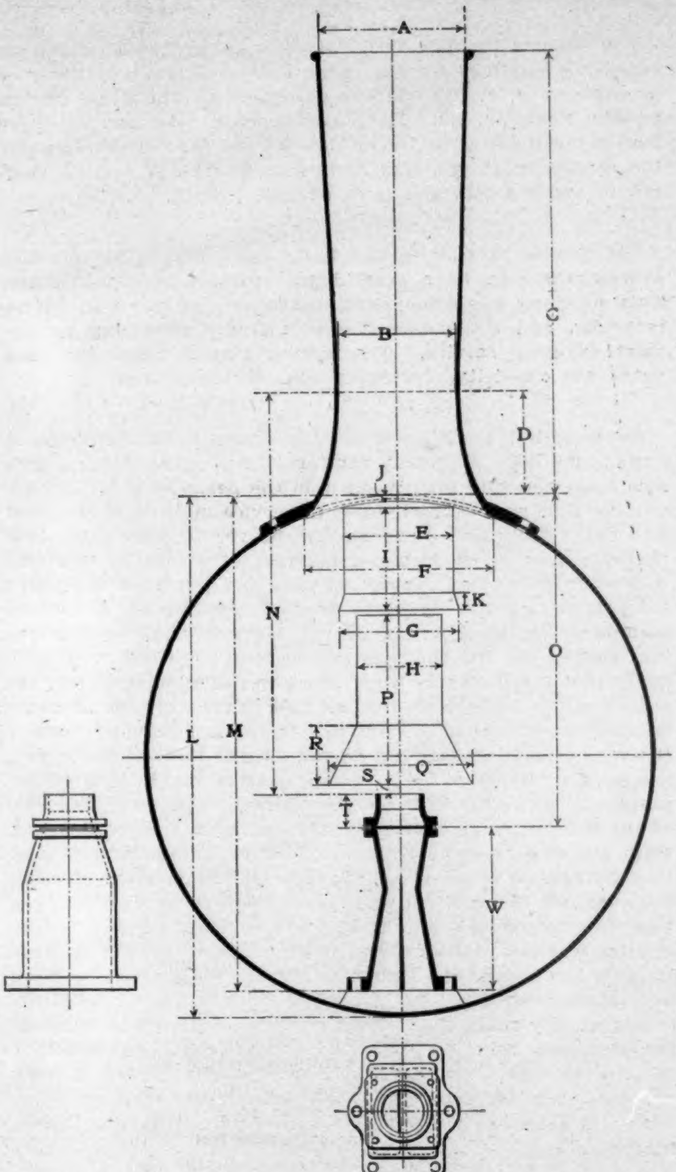
This invaluable publication, which began 33 years ago in a volume of 442 pages, representing a mileage of 39,250, has grown to 1,900 pages, containing statements of 3,691 corporations, covering a mileage of 194,321. These statements are official, because they are all revised in the proof by the railroad companies before publication, and they present at a glance information which would otherwise be beyond the reach of people actively engaged in affairs, as it is a compilation by experts after a vast amount of laborious research. Steam railroad statistics occupy the most prominent place in this record, and next in importance is the city and suburban system of railways, which has been revolutionized by the introduction of electric traction and is now undergoing a most extraordinary development. In the manual the statements of these roads are presented in the same comprehensive form as those of the steam lines. Most of the railroads do not cover more than two years in their comparisons, and when it is necessary to make comprehensive comparisons for a series of years, this manual is the only publication which may be consulted with confidence. It has been customary to give, from time to time, exhaustive analyses of the affairs of important companies by carefully prepared historical statements. In this volume is such a study, which was referred to in our November number. As a result of its continuous publication, this work preserves the histories, records and statistics of all the railroads ever built in this country, and in this field alone it has done monumental service to not only the railroads, but to the investor, the historian and the public. Another valuable feature of the work lies in the officially revised maps of the leading railroad systems, whereby the geographical importance of the lines is emphasized. Not the least of the valuable features of this publication is the promptness of its appearance and the presentation of statistics of the finances and resources of the United States and State municipal indebtedness. So closely are the railroad interests identified with the progress and prosperity of the nation that a record of this kind has become an index of the public welfare. It is a work with a history of its own, and is a chronicle of the greatest development the world has ever seen.

The new catalogue just issued by the Chicago Pneumatic Tool Company is an elaborate pamphlet on the subject of pneumatic appliances. It contains no long descriptions of the machines, but presents many large clear engravings showing the tools of these manufacturers in operation on recently constructed buildings and other prominent structural work. The great variety of service to which these tools are put is forcibly shown by the excellent engravings of this catalogue. The Commissioners at the Pan-American Exposition awarded this company the only gold medal for pneumatic tools, and also a silver medal for their exhibit.

.... *Railroad.* *Date,* ....

American Engineer Tests of Locomotive Draft Appliances.

Data Concerning Practice With Large Locomotives.



	Passenger Engines, 64-In. Boilers and Upwards.	Freight Engines, 64-In. Boilers and Upwards.
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Remarks—

We are sending copies of this diagram to the members of the motive power officers' committee and others who are following these tests, in order to secure data with reference to present practice in draft appliances for large engines. Those who do not receive this in another way will confer a favor upon us and aid in the investigation which Professor Goss is making for us by kindly filling out this information pertaining to their practice and sending the page to the editor of this journal, 140 Nassau street, New York.

Mr. William Durham Sargent, President of the American Brake Shoe Company, and also of the Sargent Company, has been elected President of the National Founders' Association. In addition to the many inventions of improvements in brake shoes, Mr. Sargent is known as one of the most prominent manufacturers of cast steel, and for the successful development in this country of the Tropenas steel casting process.

Mr. T. H. Symington, formerly Superintendent of Motive Power of the Atlantic Coast Line, and later President of the T. H. Symington & Co., Baltimore, has accepted a position as representative of the Gold Car Heating Company, of New York and Chicago. He remains President of the Symington Company.

The development of the steel car industry cannot be better illustrated than by the fact that the Pressed Steel Car Company built in 1897 501 cars; 1898, 2,931 cars; 1899, 9,624 cars; 1900, 16,671 cars; up to and including November, 1901, 23,381 cars, making a total of 53,106 cars.

Mr. Joseph H. Washburn has been appointed manager of the Roller Bearing and Equipment Company, of Keene, N. H. He was formerly draftsman for the Ball Bearing Company of Boston, under Mr. W. S. Rogers. Mr. Rogers appointed him in accordance with his policy of taking young men into his service and giving them important responsibilities. The effect of this policy is clearly shown in every enterprise with which Mr. Rogers has been connected.

EQUIPMENT AND MANUFACTURING NOTES.

Officers of the American Locomotive Company say that plans have been made to double the capacity of the company's most important plants in consequence of the unprecedented demand for locomotives. This demand comes from all parts of the world. Plans were made some time ago for enlarging the works at Schenectady, and the work is nearly completed. Now the details are being arranged for extensive additions to the Brooks works at Dunkirk.

Mr. Charles T. Schoen, former president and founder of the Pressed Steel Car Company, has resigned as chairman of the board of directors, and his son, E. A. Schoen, has resigned as one of the directors. The Schoens will devote their time to starting the $5,000,000 plant which is to manufacture rolled steel car wheels at Allequippa, near Pittsburg. It is reported that they have sold nearly all their stock in the Pressed Steel Car Company.

The extent to which the Alexander engine and car replacer is used on railroads of this and other countries is forcibly shown by a large number of specimen orders received by that company, reproduced in one of their recent pamphlets. This booklet is devoted entirely to these printed orders and to valuable testimonials from prominent railroad officials. A pair of these replacers are sent for trial and approval at the manufacturer's expense. The address of the Alexander Car Replacer Manufacturing Company is Scranton, Pa.

The Billings & Spencer Company, Hartford, Conn., report largely increased demand for their machinery and drop forgings of special design. Their facilities for making these are not surpassed anywhere. The attention of our readers is specially directed to the following tools, the excellence of which is guaranteed by the name of the manufacturers: Adjustable wrenches, 10, 14 and 18 ins. in size, shown on page 14 of the Billings & Spencer Catalogue, carbon tongs on page 18; genuine Parker ratchet drill, railroad Parker ratchet drills, and Billings double action ratchets; drop forged lathe dogs with straight and bent tails; clamp dogs, drop forged machinists' clamps, screw drivers, calipers, gauges and machinists' hammers, shown on pages 44 and 45 of the catalogue. These hammers are of excellent quality, and the "B and S" and machinists' wrenches are noted for their high grade. A large line of machine wrenches is shown on pages 60 to 77, and another specialty of this company is the manufacture of special and standard eyebolts.

The principle of applying cork insets to brake shoes is well known to our readers through the tests by the Master Car Builders' Association committee on laboratory tests, which were recorded on page 269 of our August number of the current volume and by other previous references. We are informed positively by Mr. W. W. Whitcomb, of the Allston Foundry Company, the manufacturers, that the cork does not burn in the shoes under the action of the brakes. Mr. Whitcomb has recently applied the insets of cork to the rims of belt pulleys with what appear to be remarkable results, although the tests are not yet completed. In the Worcester Polytechnic Institute Journal of October, 1901, is an account of the tests which are being conducted on these pulleys at that laboratory. The pulleys are of cast iron or of wood. In their faces corks 1 in. in diameter are inserted. These corks are about 2½ ins. apart on the circumference of the pulley and distributed across the face to give a uniform bearing surface to the belt. The corks are forced into cocked sockets less than ½ in. deep, and protrude slightly above the smooth face of the pulley. Results of the tests show that when the belt is in the least favorable condition for the "Compo" or iron pulley with cork inserts, this pulley carries more load with allowable slip than any of the others, and when the belt is in the least favorable condition (i. e., dry) for the plain iron, wood, and wood with leather face, the increase in favor of the "Compo" or iron pulley with cork inserts, is more marked. From the average results of over one hundred tests, the "Compo" or iron pulley with cork inserts at a point of 2 per cent. slip (which is considered allowable in commercial practice) shows an increase in its power transmitting capacity of 51 per cent. over the plain iron pulley.

Wood's patent car grate has been adopted for all the cars of the Boston Elevated Railway, and for this service a new form of folding gate, 5 ft. 6 ins. high, will be used. These gates are also in use on the New York Central; New York, New Haven & Hartford; the Boston & Maine, and other roads. They are manufactured by the R. Bliss Manufacturing Company, Pawtucket, R. I.

The Colburn Machine Tool Company are breaking ground for extensive buildings for the manufacture of specially designed machine tools for railroad and car shops, at Third and Buffalo streets, Franklin, Pa. The Lake Shore & Michigan Southern Railway will run their tracks through the yard in order to give the concern good shipping facilities. The plant will be modern in every detail, and is excellently located.

The Fowler Elastic Enamel Paint Company, of 390 Wabash avenue, Chicago, have entered the railroad field vigorously. This company has made tests on the cars of two well-known railroads, and the results are exceedingly promising in this most exacting service. The special claims made for their paint are elasticity, durability and decreased cost.

The growth of the Pintsch lighting system in the Dominion of Canada has been especially rapid in the past two years and is now being speedily introduced into service in Mexico. During October and part of November the Mexican Central Railroad has ordered Pintsch light equipment for 52 cars and it is probable that all their better class of cars will be equipped with that system as rapidly as they are put into the shops for general repairs. Work is now in progress on a Pintsch manufacturing plant in the City of Mexico. This work is being constructed for the Mexican Central Railroad, but it is likely that it will supply other Mexican railroads entering that city, and it is presumable that all such roads will soon be using this improved method of lighting. In the Dominion of Canada the recent point of activity, so far as this light is concerned, has been at Moncton, N. B., where a plant will be erected for supplying gas to the Intercolonial Railway. About 50 per cent. of the serviceable passenger cars belonging to the roads in the United States are now equipped with the Pintsch light, and this percentage is being rapidly increased each year. During the year 1900 the addition was one of the largest since the gas was first introduced into this country. This method of car lighting was not pushed so vigorously in either Canada or Mexico as it has been in the United States, for these countries were not under control of the American company until within a comparatively short time. Now the same active and successful efforts are being employed, both to the north and south of the United States, by the American company, and it is very probable that the percentage of gas lighted cars in those countries will soon come up to the point attained in the United States.

The total number of cars, locomotives, buoys, etc., throughout the world now equipped with the Pintsch system of lighting is given in the following table, which shows, up to May, 1901, an increase during the past year of 7,482 cars, 451 locomotives, 30 gas works and 124 buoys and beacons.

Countries.	Cars.	Locomotives.	Gas Works.	Buoys & Beacons.
Germany	38,218	4,285	71	98
Denmark	45	...	3	21
England	18,611	18	87	272
France	6,618	...	27	240
Holland	3,318	5	10	83
Italy	1,528	...	5	15
Switzerland	380	2	1	...
Austria	3,777	...	10	1
Russia	2,845	102	13	13
Sweden	591	29	4	2
Servia	169	...	...	...
Bulgaria	98	...	1	...
Turkey	112	...	...	...
Egypt	2	...	3	112
Canada	75	...	2	60
Brazil	974	3	1	33
Argentine	1,046	...	10	2
Chili	46	...	2	...
India	8,058	...	16	...
Australia	2,053	...	13	29
United States	17,000	...	54	162
Japan	100	...	2	4
China	....	...	1	15
Total	105,664	4,472	336	1,162